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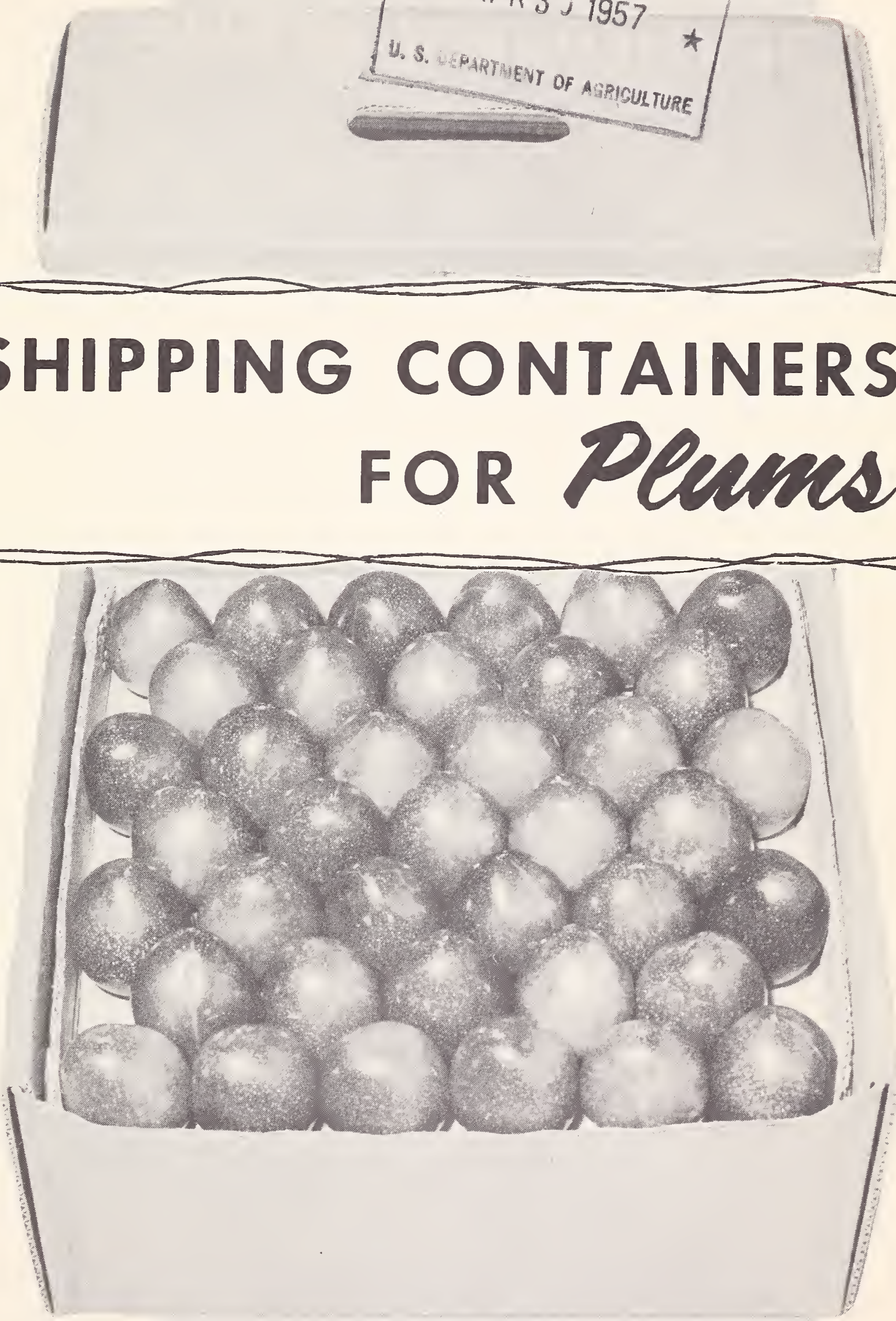

NEW SHIPPING CONTAINERS FOR *Plums*

Marketing
Research
Report
No. 128

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE

Washington, D. C. ● ● ● June 1956

ACKNOWLEDGMENTS

Credit is given the following for assistance and cooperation: Harold Angier, manager, California Grape & Tree Fruit League; New York Fruit Auction; Chicago Fruit Auction Sales Company; fruit receivers and shippers' agents at terminal markets for price quotations and market information; container manufacturers who worked out new designs and supplied experimental containers; and suppliers of carton material.

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CONTENTS

Page

Summary iii

Need for cheaper containers 1

Development of new containers 1

    Advantages and disadvantages of 4-basket crate . . 2
    Specifications for hypothetically perfect container 5
    Preliminary packing tests of experimental containers in 1952-53 6

Performance of new containers in 1953 and development of improvements 9

    Market reaction 11
    Changes in design and construction 15
    Changes in loading 16
    Face-pack and jumble-fill 16
    Face-pack with fill place-packed 17

Evaluation of new containers in comparison with standard crates in 1954 19

    Cost of containers 24
    Cost of materials and assembly 27
    Suitability and cost of packing 27
    Suitability and cost of loading devices 28
    Arrival condition of plums in 1954 replicated shipments 31
    Trade acceptance and salability of plums 31

Progress and appraisal of 1955 commercial shipments of new containers 33

    Cost of container 34
    Methods of loading. 37
    Arrival condition of plums. 37
    Analysis of prices received 38

Advantages and disadvantages of individual containers 42

SUMMARY

New shipping containers which permit substantial reductions in the cost of marketing fresh western plums have been developed and evaluated under a 4-year research program. Development and evaluation of the new experimental containers was undertaken by the California Grape & Tree Fruit League under U. S. Department of Agriculture contracts.

The new containers--fiberboard boxes--are cheaper than the standard 4-basket crate now in general use. They also require less packing labor and permit savings in loading costs of rail shipments. Although plum packing costs vary from year to year, estimated potential savings, based on packing and shipping tests in 1954, ranged from 19 to 30 cents a crate depending upon the type and design of the container used. This would amount to 1 million dollars a year if these containers were generally adopted by the industry.

The research included test shipments of plums in the new containers so that the arrival condition and acceptance of the plums by the trade in eastern markets might be compared with those of similar size, variety, maturity, and quality shipped in standard 4-basket crates under like transit conditions in the same freight car.

More than 30 experimental containers from a dozen cooperating manufacturers were screened in an effort to satisfy exacting requirements developed under the project. Four of them performed satisfactorily and two of them were used commercially by plum shippers in 1955.

The four containers were all of fiberboard material with inside dimensions 12½ inches square by 7 inches deep. Each was designed to pack a constant 25 pounds of plums. Brief descriptions follow:

Container 8B-29.--A 2-piece full telescope box with roll ends which fold into place. Its 2 cut-down sides eliminate the appearance of a slack pack after the normal settling of plums in transit; it could be set up by hand and therefore was adaptable for smaller plants. It was most popular with the trade.

Container 9B-24.--A half-slotted container with 2-inch top flaps turned out and down; full depth liner and 2-inch telescoping cover fit over the container flap. Also made with a self-locking roll end cover 2½ inches deep. Its overlapping covers help create air channels between adjoining stacks and rows when loaded for shipment. (A half-slotted container is one with flaps for closure on either top or bottom.)

Container 10B-23A.--A 2-piece full telescope box with inner and outer case of half-slotted design. Although it was not as sturdy as the other 3 containers, it performed adequately, and it was the cheapest.

Container 9B-25.--A regular slotted container with full liner and tear-tape feature for opening. (A regular slotted container is one with flaps for closure on both top and bottom.) The chief feature of this container was a removable 1½-inch strip at the top of the inner liner. When the strip was removed with the cover there was no appearance of a slack pack. This container could be mechanically sealed.

More than 10,000 experimental containers of various designs were test shipped from western packing houses to eastern auction markets in 1953 and 1954. Approximately 30,000 were shipped commercially in 1955. In the beginning a face-and-fill method of packing was used. The jumble-fill did not provide adequate support and the face became disarranged in transit. A face pack in a tray was substituted. To provide an even support for the tray a place-pack was devised for the fill.

Plums in the new containers sustained somewhat more slight bruising than did plums in 4-basket crates. However, this slight bruising--a flattening of the contour of the plum--did not cause lowering of grade and was taken lightly by the trade. There also was more damage by bruising and more serious damage in the experimental containers, particularly in the test shipments in 1953 and 1954. However, these types of injuries were greatly reduced in 1955 commercial shipments by the substitution of a flexible tray for a rigid tray and by increasing the depth of the container.

Prices paid for plums shipped in 4-basket crates averaged slightly higher than those paid for plums in experimental containers. Many wholesale buyers expressed a preference for the 4-basket crate although on a per pound basis they frequently paid as much or more for plums in the new containers. In general, the retail trade reacted favorably to the new containers.

Although there are some problems left to be worked out by the plum industry, these containers offer many potential economies because of lower cost, lower freight and loading costs, and because they lend themselves to the eventual development of a volume-fill pack which would reduce packing labor. It is probable that eventually plums can be mechanically sized for packing in these containers. This would greatly reduce the amount of skilled labor now required to eye-size plums, an essential feature to the place-pack arrangement in the 4-basket crate.

NEW SHIPPING CONTAINERS FOR PLUMS

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NEED FOR CHEAPER CONTAINERS

In 1951, the second most abundant crop of fresh western plums on record, combined with low prices, focused attention on the relatively high cost of shipping containers for this fruit. [1]

The cost of the standard 4-basket crate and the cost of packing and loading it amounted to only a few cents less than the entire on-tree per crate return to the grower for his plums. The skilled labor required for eye-sizing and hand-packing the plums individually in each of the four baskets not only was costly, but frequently was inadequate to keep the fruit flowing smoothly from the pickers to the waiting refrigerator cars.

Growers reported that the 4-basket crate for plums, on an equivalent weight basis, cost as much as 60 percent more than the standard wood box for California pears and 20 percent more than that for peaches.

The cost of a crate, together with its component baskets, shims, collar, curtain, or pad and liner, including the cost of assembly, averaged about 50 to 60 cents. All packinghouse costs, including overhead, precooling, and loading, averaged about 50 cents. The total crate and packing cost ranged from $1 to $1.10. The average 1951 on-tree return to the growers was $82 per ton, which was equivalent to approximately $1.10 to $1.20 per crate.

DEVELOPMENT OF NEW CONTAINERS

This research project was undertaken to develop a shipping container which would be less expensive than the one in general use and which also would permit savings in packing and loading costs. An equally important objective was to develop a container which maximized the salability of the plums. The research on this study was conducted during 1952, 1953, and 1954, by the California Grape & Tree Fruit League, a nonprofit organization of growers and shippers, under contract with the U. S. Department of Agriculture.

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[1] In 1951, the total U. S. plum production of 101,800 tons was exceeded only by the 1946 record of 106,000 tons. The average 1951 on-tree return to growers for plums in interstate shipments was $82 a ton compared with $127 in 1950, and $184 in 1952.

The major part of the field work was carried out by the contractor. Participation of Department personnel was limited to observing test shipments and advising the contractor on changes in containers and methods of loading the containers in cars. All results and test data were furnished to the Department, and at the end of each season the progress of the work was reviewed jointly by research workers of the Department and the contractor, and by an industry advisory committee set up for that purpose. The final analysis, summation of the work, and the preparation of this report were also the joint efforts of the Department and the contractor.

The Plum Container Advisory Committee, whose members are experienced growers and shippers, assisted the contractor in making a critical analysis of the favorable and unfavorable characteristics of the containers in use. These were the (1) standard 4-basket crate in which most plums were packed for shipment out of State; (2) the California peach box in which large plums were individually wrapped; and (3) the Brentwood lug in which small plums were face packed with a jumble fill. Because the peach box and lug were generally used only for packing extreme sizes, the performance of the newly developed containers was compared with that of the 4-basket crate.

Advantages and Disadvantages of 4-Basket Crate

Advantages of the 4-basket crate are:

1. The four 5-pound baskets within the crate taper from 8 inches square at the top to $6\frac{1}{2}$ inches at the bottom (fig. 1). The sloping sides accommodate slight variations in plum sizes between layers, but at the same time tend to control variations beyond the one quarter inch authorized by the Agricultural Code of California.

2. Since irregularities are readily apparent in the 4-basket pack, size grading enforcement is easy.

3. Most sizes of plums are accommodated.

4. The sloping, resilient sides of the baskets permit snug packing which minimizes jostling in transit, reduces bruising, and maintains neat face alinement despite the normal shrinkage in transit.

5. The tapered baskets provide air channels, thus facilitating precooling and refrigeration.

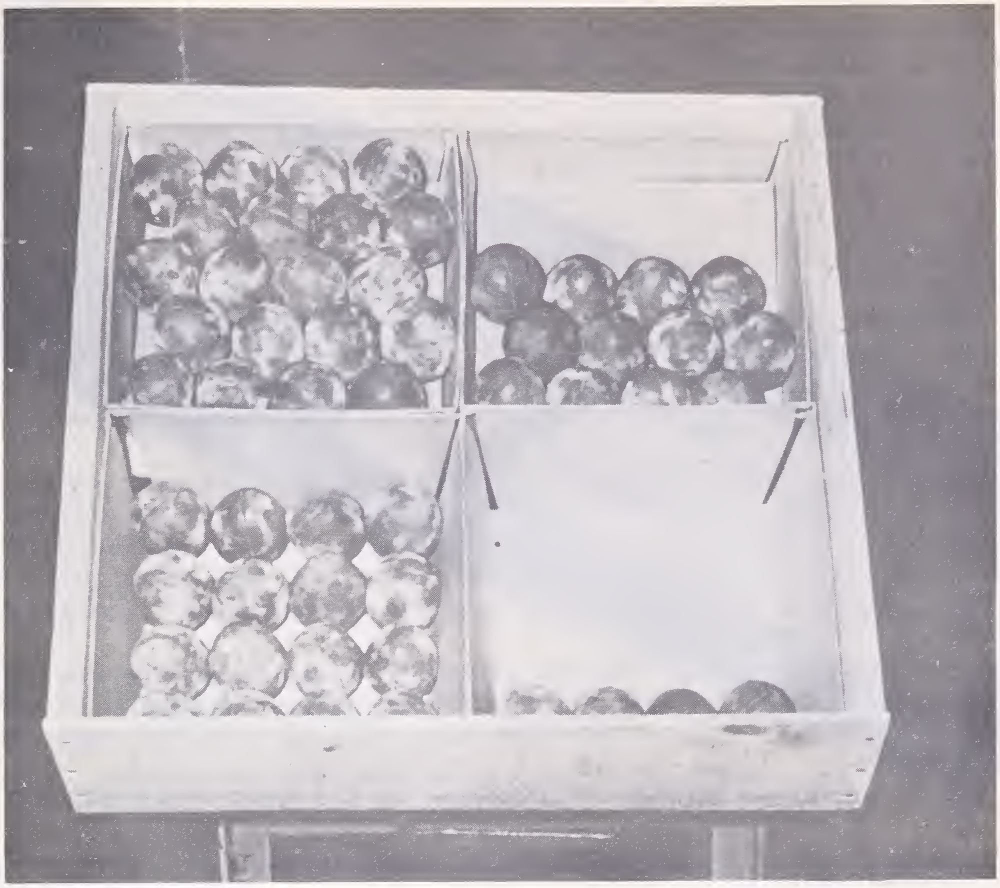

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Figure 1.--The standard 4-basket crate. The first of the 3 layers of plums ordinarily packed is being started in basket at lower right. The completed first layer is in the basket at lower left. The second layer has been started on top of a shim in basket at upper right and a completed second layer is at upper left. Note that there are 4 rows of 4 plums in the first layer. Because of the tapering sides there is room for 5 rows of 4 plums in the second layer. The top layer--not shown--also will have 5 rows of 4 slightly larger plums in each.

6. Because of individual handling and the lavish use of protective materials such as the baskets, shims, pads and collars, this container provides good protection to plums of advanced maturity.

7. Favorable trade acceptance of the 4-basket crate has been established, and the row pack within the baskets provides an attractive appearance for both wholesale and retail display.

Some of the disadvantages of the 4-basket crate are:

1. Material costs are extremely high because of the large number of component parts (fig. 2).

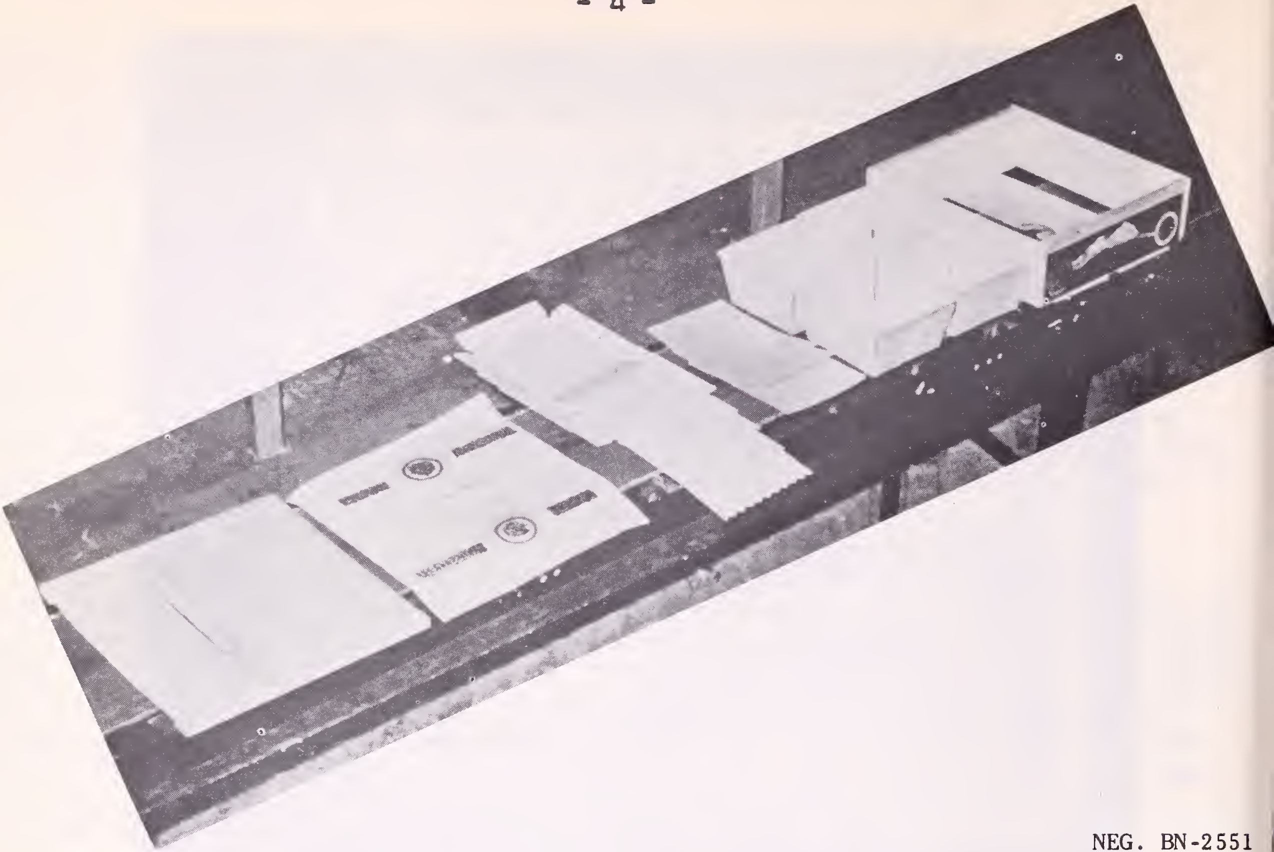

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Figure 2.--Component parts of the standard 4-basket crate. On the right is the body of the crate. Next are the 4 wood veneer baskets which are inserted in the crate and in which the plums are packed. To left of baskets are 4 cardboard shims, used to cover the first layer of plums in each basket. Next are 4 collared shims which are placed on top of the second layers of plums and which form trays in which third layers are packed. Next is a paper sheet which is placed on top of the 4 packed baskets. Far left is wooden cover.

2. These component parts add to the time consumed in packing and therefore to the labor cost.

3. The many parts create inventory control problems.

4. Another inventory problem is presented by the varied sizes of the crate; the sizes range from 4½ inches to 6 inches in height.

5. The crate and its component parts have little, if any, re-use value.

6. The nature of the pack requires skilled eye-sizing and hand-placing of each plum, resulting in high labor cost.

7. The placing of the plums in the baskets, always 3 layers deep, results in wide variations in net weight, thus failing to attain the constant standard weight generally desirable in merchandising.

8. The good but expensive display features are often wasted inasmuch as many retailers do not exhibit plums in the baskets or crates but put them on display in mass stacks or in retail size containers. Prices of the 4 component "5-pound" baskets, which actually contain from less than 6 to more than 8 pounds each, tend to discourage purchases of full baskets.

Following appraisal of the 4-basket plum crate, packing methods and containers employed by shippers of other fruits and vegetables were carefully observed in a search for ideas that might apply to the plum industry. Lemons, packing plants for which are highly mechanized, and tomatoes and lettuce, both extremely perishable, were among the items of produce to which particular attention was given.

Findings were compared with procedures employed by plum shippers, and consideration was given to varieties of plums currently popular, dates of maturity, handling and carrying qualities, areas of production, location of markets, facilities and equipment available for packing, precooling and transportation, inspection and auction procedures, and trade prejudices.

With all available facts in focus, the characteristics and broad specifications of a hypothetically perfect plum container were drawn up by the Plum Container Advisory Committee as follows:

Specifications for Hypothetically Perfect Container

A shipping container designed to transport western fresh plums to interstate markets should be:

1. Of sufficient depth to be volume filled easily (upside down pack) over a row face in the bottom of the box, and able to accommodate any and all sizes and varieties of plums.

2. Large enough to hold 25 to 30 pounds of plums regardless of the variety or size of each piece of fruit. If possible, a uniform weight should be maintained regardless of variety or size.

3. Made of material that will provide a cushion for each piece of fruit coming in contact with it so as not to bruise the fruit.

4. Of sufficient strength to stack at least 12 boxes high and to maintain that strength at high humidity and temperature conditions.

5. Of sufficient tensile strength to minimize and, if possible, eliminate breakage in transit.

6. Provided with a method of opening for inspection that allows attractive and simple reclosing on the face side.

7. Designed to require a minimum of labor to unpack at the retail level.

8. Suitable for shipping under refrigeration.

9. Designed with a minimum bottom area to be row-packed but at the same time sufficiently large to make an attractive face for inspection at the wholesale level.

10. One that permits a so-called face-and-fill pack, as indicated above, in order to:

    (a) Give an attractive appearance when opened.

    (b) Provide a row count comparable to the present method of size determination.

    (c) Minimize the number of parts to buy, store, and handle, eliminating excess components which now serve only to dress up the pack.

In addition to the 10 specifications listed above, the committee considered it desirable to develop a box which could be used for ranch packing or house packing without expensive machinery, while at the same time lending itself to the most modern mechanized handling.

The characteristics of both the container in use and the hypothetically perfect container were given to manufacturers and their trade associations with the request that they submit ideas and sample containers for testing.

Preliminary Packing Tests of Experimental Containers in 1952-53

By the time the first samples were received from the manufacturers, the 1952 season was well advanced and no shipping trials could be arranged. However, packing tests in the new experimental containers were begun immediately. One of the first tested was a fiberboard container made to the Brentwood lug size specifications of 16-1/8" x 12½" x 6" and 6½". It was found to be too flexible along the long axis to maintain a row face properly, and its gross weight was too great for easy handling.

More experimental packings were made in containers of the same height and width but shorter lengths. When the container was squared at 12½ inches, inside dimensions, and the height maintained at 6 or 6½ inches, it was found that it packed well with the few varieties available at the time. What was considered more important, was the fact that a well-packed box contained few voids or empty spaces, and the net weight of plums packed varied only slightly below 25 pounds, which was considered an ideal weight.

Of almost 30 experimental containers, 2 were selected at the end of the 1952 season for tests under commercial conditions during 1953. One of these was replaced by an improved version early in the shipping season, and four additional newly submitted models also were tested that year.

The two containers first tested in 1953 were designated 10B-23 and 9B-24. The 10B-23 consisted of 2 half-slotted containers which slipped over a full depth sleeve. For the first 3 shipments this container was made with the top half and the bottom half separate and held in place by tape for closure. In subsequent shipments, top and bottom halves were not completely severed when manufactured--a 3-inch strip on each side was left uncut (fig. 3).

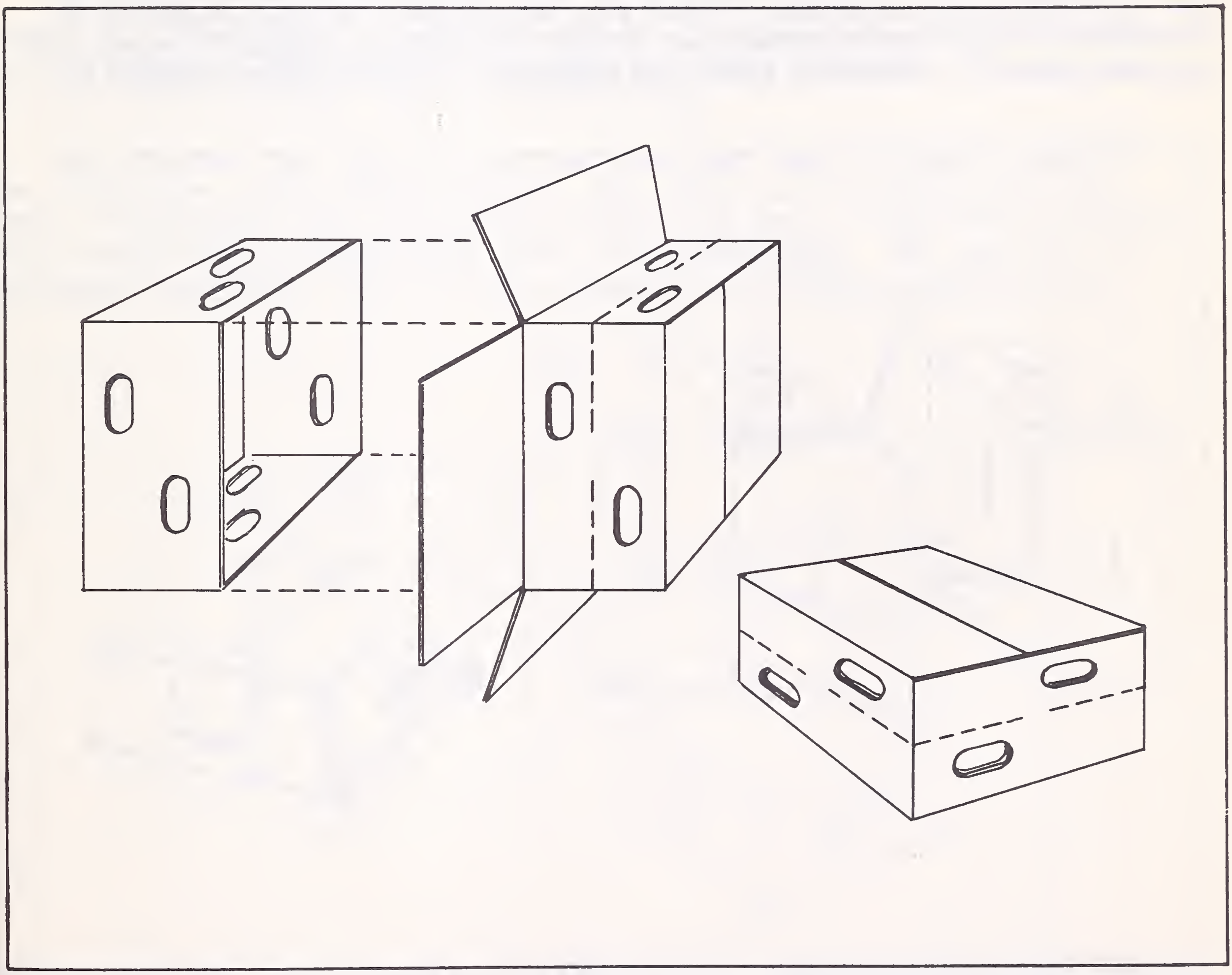

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Figure 3.--Experimental container 10B-23. Except for 3 inches in the middle of each side, all 4 sides were cut as indicated by dotted lines to permit removal of the cover for inspection of the plums inside. Once the cover was removed, it was impossible to fasten the cover in place again without staples or tape which detracted from the appearance of the container. The perforations weakened the sides, and the container tended to bulge. It was abandoned early in the program.

This strip was cut when the box was opened for inspection. This container originally had 4 openings, 1 x 3 inches, on 2 sides for ventilation. These later were reduced to two 1 x 1½-inch oval vents on 4 sides.

The 9B-24 was a half-slotted container with 2-inch top flaps and a 2-inch telescoping cover (fig. 4). It had a full depth liner and 1 x 3½-inch hand-holds on 2 sides for ventilation.

During 1953, 4,868 experimental containers were packed with 120,506 pounds of plums and shipped from 8 California loading points to the auction markets in Chicago and New York. A total of 11 shipments were made under commercial conditions. There were 9 mixed carloads of experimental containers and standard 4-basket crates. There also were 2 full carload shipments of experimental containers accompanied by full carloads of standard crates containing plums of comparable grade and maturity. Federal-State inspection

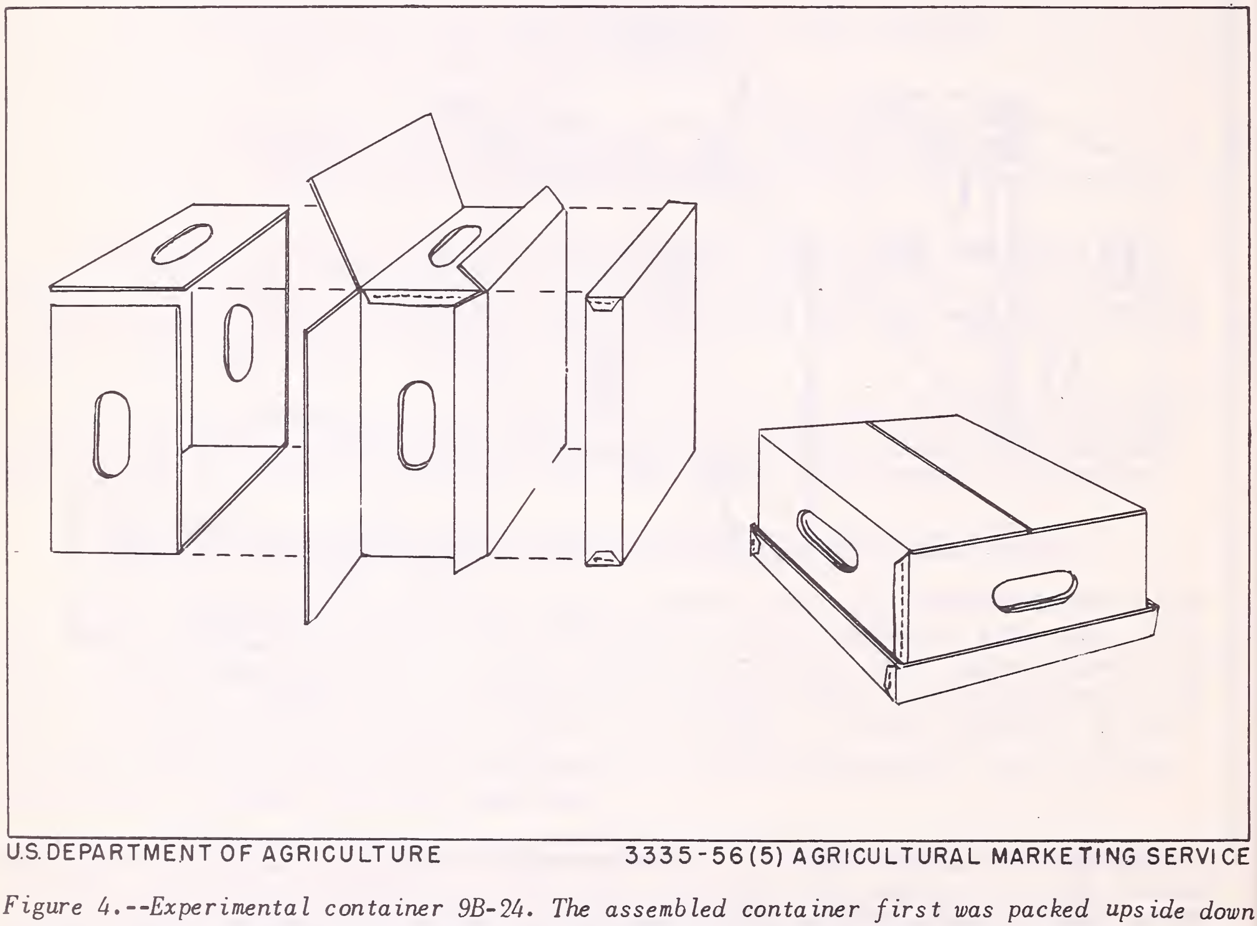

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Figure 4.--Experimental container 9B-24. The assembled container first was packed upside down with a face-and jumble-fill. When a tray was added to hold the face, the container was packed right side up with the fill going in first and the face last. Note the overlapping cover which creates air channels between the rows where the covers in adjacent rows come in contact and held the rows apart.

certificates were obtained at points of origin, and Federal Inspection Service representatives examined the plums at the terminal markets.

PERFORMANCE OF NEW CONTAINERS IN 1953 AND DEVELOPMENT OF IMPROVEMENTS

Most of the 1953 tests were devoted to appraisal of 3 containers: the 10B-23, 9B-24, and 10B-23A (table 1). Three other containers which were tried soon displayed features which indicated they were not sufficiently promising to warrant extended tests. A seventh container was not submitted until the plum season was almost over.

Weakened by too much surface area in ventilation holes and by half-telescope construction, the original 10B-23 container and subsequent modifications bulged in the middle upon arrival in eastern markets. On the other hand the 9B-24 container appeared quite sturdy.

The 10B-23A (fig. 5) container was developed when attempts to improve the performance of the 10B-23 failed. The 10B-23 was withdrawn from the tests. The 10B-23A was a full-depth telescoping box. It was used initially with a right-side-up jumble-fill and a face-packed tray. The tray was of corrugated paperboard, 12-3/8 inches square with 1½-inch stapled collar.

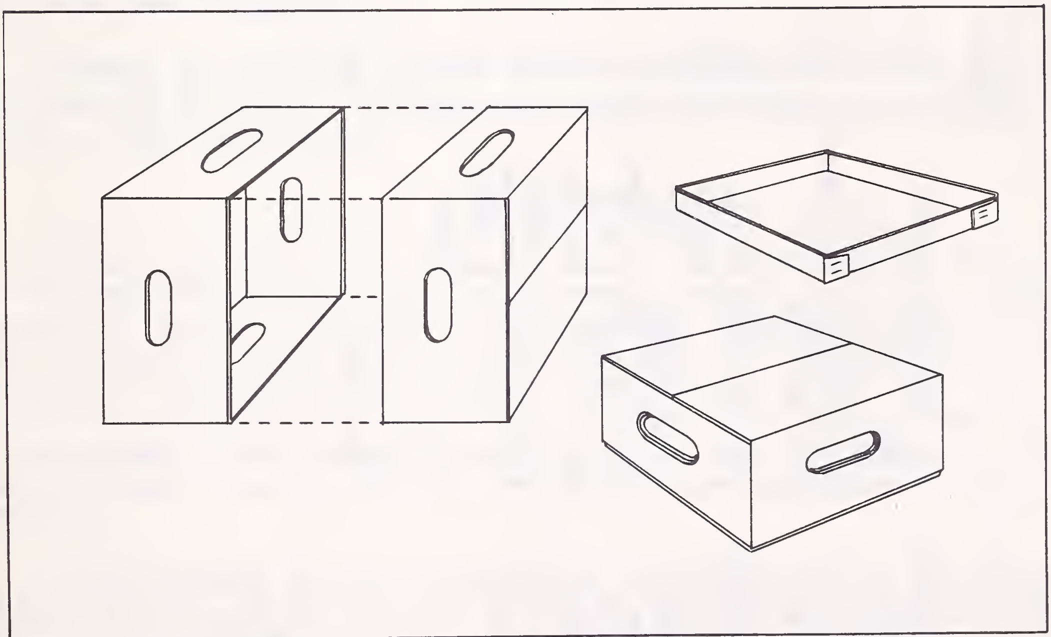

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Figure 5.--Experimental container 10B-23A, a full telescope which was substituted for the 10B-23. The 10B-23A was packed with a fill and a face pack in a tray, which is shown at right above the assembled container.

Table 1.--Test shipments of fresh western plums in specified experimental containers and in 4-basket crates by date, variety, point of origin, and destination, 1953

Shipment code number	Date of shipment	Point of origin	Date sold	Place sold	Variety	Experimental containers				Standard containers	
						10B-23	9B-24	10B-23A	Other	4-basket crate	Other
						Number	Number	Number	Number	Number	Number
1 . .	6-2	Di Giorgio	6-9	New York	Beauty	36	36	-	-	855	-
2 . .	6-5	Cutler	6-16	do.	do.	36	37	-	-	977	-
3 . .	6-8	Loomis	6-17	do.	do.	37	36	-	-	956	-
5 . .	7-9	Exeter	7-15	Chicago	Santa Rosa	15	234	8	-	520	-
6 . .	6-26	Fresno	7-6	New York	do.	469	-	1	-	470	-
7 . .	7-7	Di Giorgio	7-17	New York	Wickson	246	-	-	2	427	-
					Duarte	174	-	42	2	93	-
9 . .	7-25	Loomis	7-31	Chicago	do.	-	462	-	-	326	-
10 . .	8-1	Tudor	8-10	New York	L. Tragedy	-	1,043	2	11	-	1/ 1,037
11 . .	7-29	Loomis	8-5	Chicago	do.	-	414	-	6	-	1/ 499
13 . .	8-12	Reedley	8-19	do.	President	-	99	299	-	499	-
					L. Duarte	-	69	-	-	69	-
14 . .	8-15	Newcastle	8-24	New York	President	-	-	416	-	360	2/ 10
					L. Duarte	-	-	542	-	541	-
					Kelsey	-	-	53	41	44	2/ 50
			Total boxes			1,013	2,430	1,363	62	6,137	1,596

1/ Brentwood lugs.
2/ Peach boxes.

Where the fiberboard containers had been in contact with rigid wooden bulkheads and separators, they were creased and scuffed. Stacked high on the floor of the auction display pier where they should look their best, the experimental containers often leaned and were unstable. There was extensive bruising, although most of it was slight.

The plums settled in transit and the obvious slackness made it appear the containers had not been fully packed. And worst of all, the face often was in a state of almost complete disarray. And if the face in the 10B-23 survived the jostling train ride, and rough handling on the pier, it frequently was jumbled when removal of the top half of the container tended to pull loose the liner.

Table 2 shows the arrival condition at terminal market of plums packed in experimental containers and in standard crates and Brentwood lugs. It indicates that in most cases, bruising, both slight and severe, was somewhat more in the experimental containers than in the standard containers, although the difference was not great.

The "slight bruising" reported refers to minor distortions or flattening of the fruit by pressure, either against the interior of the package or from contact with other plums. This bruising detracts from the appearance of the plums at the auction, but when the plums are put on display at the retail store the distortion or flattening seems to disappear. Slight bruising does not cause loss of grade.

"Damage by bruising" is more severe flattening or definite breakdown of the flesh of the fruit. It may cause rapid deterioration and decay of the plums; it may affect grade.

Market Reaction

Market reaction to the early shipments was unfavorable. The appearance of the experimental containers--drab brown, creased, and often bulging--got a negative reponse. The buyers at the eastern terminals expressed the view that the quality of the fruit normally is reflected in the quality of its container. They felt that a shipper ordinarily would pack his most select fruit in the fanciest and highest priced containers, leaving the lower grades to be shipped in less costly packages. Prices paid for plums in the first colorless experimental containers reflected this conviction on the part of the buyers.

Auction buyers and wholesalers also were suspicious of the jumble-fill. During World War I and following it the markets were flooded with jumble-fills of plums of uneven sizes and mixed quality packed in Los Angeles lugs. Although the Agricultural Code of California now stipulates that plums must not vary more than 1/4 inch in diameter in any one container and although Federal and State inspections are made at the shipping point to enforce the regulations, the buyers have not overcome their distrust. They want a gage with

Table 2.--Arrival condition at terminal market of plums packed in experimental containers and of plums packed in 4-basket crates and Brentwood lugs, by percentage of plums sustaining slight bruising, damage by bruising and decay, 8 test shipments, 1953 (as indicated by inspection certificates of the Fresh Products Standardization and Inspection Branch, Fruit and Vegetable Division, Agricultural Marketing Service, U. S. Dept. Agr.)

Shipment code No.	Variety of plums	Experimental containers									Standard containers					
		10B-23			9B-24			10B-23A			4-basket crate			Brentwood lug		
		SB 1/	DB 2/	DK 3/	SB 1/	DB 2/	DK 3/	SB 1/	DB 2/	DK 3/	SB 1/	DB 2/	DK 3/	SB 1/	DB 2/	DK 3/
1	Beauty	20	0	0	15	0	0	-	-	-	5	0	0	-	-	-
2	do.	18	2	1	15	2	1	-	-	-	5	3	0.5	-	-	-
3	do.	12	4	0	9	3	0	-	-	-	8	6	0	-	-	-
6	S. Rosa	9	3	0.5	-	-	-	-	-	-	4	1	0.5	-	-	-
7	Wickson	15	0.5	0.5	-	-	-	-	-	-	20	0.5	0.5	-	-	-
	Duarte	17	0.5	0.5	-	-	-	15	0.5	0.5	14	0.5	0.5	-	-	-
10	L. Tragedy	-	-	-	2.5	0	0.5	-	-	-	-	-	-	6	1	0.5
11	do.	-	-	-	30	0.5	0	-	-	-	-	-	-	30	0.5	0
14	President	-	-	-	-	-	-	10	1	0	5	0	0	-	-	-
	Late Durate	-	-	-	-	-	-	8	0	0	6	0	0	-	-	-
	Kelsey	-	-	-	-	-	-	6	1	0	5	0	0	-	-	-

1/ SB - Slight bruising, not affecting grade.

2/ DB - Damage by bruising.

3/ DK - Decay.

Note: Design of container 10B-23 changed after third shipment.

Container 10B-23 packed in all shipments with upside down single face and jumble-fill.

Container 9B-24 packed in first 3 shipments with upside down single face and jumble-fill, and in shipments 10 and 11 with upside down single face, shim and jumble-fill.

Three shipments listed in table 1 are not included above because inspection reports were incomplete.

which to judge the size which is stamped on the container, and the four baskets in the standard crate provide this gage.

When, for example, plums of the 4 x 5 size were packed in the standard crate, 5 rows of 4 plums each were clearly visible in the top layer of each of the 4 baskets. The same number of plums in exactly the same order was also visible in the second layer if the buyer cared to look. If the plums were snug and in good array the buyer did not have to trust a keen eye or to reach for a caliper. He knew the plums were the size designated because the right number fit the space they were supposed to fit. With the jumble-fill the buyer had no gage or yardstick with which to judge size.

In the first test shipments in 1953, plums packed in the 4-basket crate sold at wholesale auction in the terminal markets for as much as 26 percent more than plums of comparable variety, size, and quality packed in experimental containers. The average auction price advantage for plums packed in standard crates from the sale of 15 comparable lots during the entire 1953 season was 1.2 cents a pound, or 10.4 percent more than the price paid for plums in experimental containers (table 3). However, at retail level, comparable plums packed in both experimental and standard containers generally sold for the same price in the same store.

Unlike the wholesale buyers, who considered the experimental containers less attractive than the 4-basket crates, retailers were not greatly concerned with the appearance of the containers which seldom are displayed in the store. Usually plums were removed and heaped for display in a store window, on a counter, or on a stand built for that purpose. Plums taken from the 4-basket crates and from the experimental containers and combined in a single display were indistinguishable.

The ease with which the container could be opened and emptied of its contents was of more importance to the retailer than its appearance. The standard crate was slow and untidy to unpack. Its 4 baskets, 8 shims, 4 collars and pads not only interfered with speedy removal of the fruit but also added bulk to the trash to be carted away. The fiberboard boxes unpacked easily and also could be used again as containers in which customers could carry home their purchases.

The experimental containers required less space in the retailer's storage room where fresh fruits and vegetables are usually kept under refrigeration until needed. Truckers declared that when plums were packed in experimental containers they could carry more fruit in the same space than when 4-basket crates were used. Truckers, clerks in the retail stores, and the car unloaders at the terminal declared it was safer and easier to handle the new fiberboard containers. With the wooden crates, they said, there was always the hazard of splinters or a cut from a projecting nail.

Although the fruit in the experimental containers suffered no unusual damage in the long haul across country, the terminal buyers seemed convinced

Table 3.--Comparison of auction selling price per package and per pound of plums of comparable size and variety packed in experimental containers and in 4-basket crates, 1953

Shipment code No.	California shipping point	Variety	Place sold	Experimental containers			4-basket crates		
				Average price per package	Average net weight	Average price per pound	Average price per package	Average net weight	Average price per pound
				Dollars	Pounds	Cents	Dollars	Pounds	Cents
1	Di Giorgio	Beauty	New York	3.26	23	14.2	4.28	27	15.8
2	Cutler	do.	do.	2.75	23	12.0	3.95	27	14.6
3	Loomis	do.	do.	2.59	22	11.8	3.68	27	13.6
5	Exeter	S. Rosa	Chicago	4.20	25	16.8	4.79	29	16.5
6	Fresno	do.	New York	2.76	25	11.0	4.03	29	13.9
7	Di Giorgio	Duarte	do.	2.80	25	11.2	4.41	29	15.2
	do.	Wickson	do.	2.48	25	9.9	3.60	30	12.0
9	Loomis	Duarte	Chicago	3.33	24	13.9	4.40	29	15.2
10	Tudor	L. Tragedy	New York	4.64	25	18.6	5.01	26	19.3
11	Loomis	do.	Chicago	3.74	25	15.0	3.84	25	15.4
13	Reedley	President	do.	2.52	25	10.1	3.30	29	11.4
	do.	L. Duarte	do.	2.00	25	8.0	2.18	28	7.8
14	Newcastle	President	New York	2.22	25	8.9	2.86	29	9.9
	do.	L. Duarte	do.	1.92	25	7.7	2.34	29	8.1
	do.	Kelsey	do.	2.30	25	9.2	2.43	30	8.1
			Average	2.90	24.5	11.9	3.67	28.2	13.1

that the containers were not sturdy enough to protect the fruit during their route through the wholesale level to the retail outlets. These buyers also were of the opinion that the experimental containers were too weak to be stacked any higher than the 5 or 6 layers that were loaded in the freight cars.

In order to determine the utility of the experimental containers from the terminal to the retail market, inspection was made on the wholesale and retail level, of all shipments during 1953 with the exception of the first 3 small shipments. In no case was a serious failure observed. The observations were made by fresh fruit and vegetable inspectors of the Federal Inspection Service. One inspector reported seeing 9B-24 experimental containers stacked 14 high with no apparent bulging or weakening.

After appraisal of the plums at wholesale and retail levels, the reports of the inspectors were checked against reports on the condition of the same lots of plums upon their arrival at the terminal market. Of the lots inspected when comparable fruit was available in experimental containers and 4-basket crates and direct comparisons could be made, these conditions were found:

At wholesale level, the amount of slight bruising of plums in experimental containers was reported substantially the same (within 1 percent) in 4 lots, slightly lower in 3 lots, and slightly higher in 2 lots than reported at the terminal market. The amount of slight bruising in 4-basket crates was reported substantially the same in 3 lots, slightly lower in 1 lot, and slightly higher in 5 lots than reported at the terminal market.

On the retail level, the amount of slight bruising of plums in experimental containers was reported substantially the same in 4 lots, slightly lower in 2 lots, and slightly higher in 3 lots than reported at the terminal market. The amount of slight bruising in 4-basket crates was substantially the same in 2 lots, slightly lower in 1 lot, and slightly higher in 6 lots than reported at the terminal market.

Damage by bruising and decay were substantially the same at terminal market, wholesale level, and retail outlet in both new containers and in crates.

Changes in Design and Construction

It was apparent from the start that certain containers had to be improved in design to overcome instability and bulging as well as to improve the appearance of the package. It also was considered necessary to alter packing methods to overcome disarrangement of the face and slackness of the pack.

The plum shipping season is at its height during the hot and humid months in the East where the principal markets are located. These atmospheric conditions cause condensation of moisture on the cold fruit and on the containers when they are removed from the refrigerator car at the terminal. This moisture was absorbed to some extent by the fiberboard material of the experimental containers, thus weakening the side walls during stacking operations when maximum strength was most needed. However, evaporation also was rapid and much of the original rigidity of the container soon returned.

Changes in Loading

In the early shipments, modified gate frames were inserted between adjoining stacks of experimental containers to space them for ventilation. On arrival at the terminal, all containers were creased. This creasing occurred where they had come in contact with the wood. It was concluded that wooden frames could not be used as separators and the remaining shipments during the first season were loaded without spacing frames. This eliminated serious creasing of the containers.

The lack of spacing frames had no effect on the condition of the load from the standpoint of breakage, but it did leave ventilation channels of varied width and rows in irregular alinement. The fruit in these shipments was room precooled and no appreciable difference in arrival temperature was noted. But, if fruit at field temperature was placed in the car, it was doubted if the irregular channels would provide sufficient ventilation to cool the plums.

In mixed carloads, experimental fiberboard containers were separated from the standard wooden crates by a strong wooden bulkhead spiked securely to a platform laid beneath the experimental containers, and to the car walls. This was expensive, damaging to the car, and would not work if the car had steel floor racks. Later, the bulkheads were secured in place by an arrangement of steel straps. Because of the flexible nature of the material from which they are made, fiberboard containers are not subject to breakage by normal jostling even when packed loosely enough to permit considerable shifting. More rigid wooden containers must be wedged tightly together, however, or they will suffer considerable damage. Hence, in mixed loads the bulkhead separation is essential.

Face-Pack and Jumble-Fill

With bulging and creasing under partial control, attention was shifted to development of an attractive face and fill pack that would stay in place.

In the studies for the formulation of characteristics and specifications for a hypothetically perfect container, experienced shippers on the California Grape & Tree Fruit League advisory committee had come to the conclusion that an upside down face and jumble-fill method of packing promised the greatest savings in packing labor costs. Thus, at the outset of the tests the single face and jumble-fill method was employed. In the earliest shipments in 1953, the plums in the face were laid on their sides. This method presented a less attractive appearance because of the large voids between plums and at the same time the rows were easily disarranged. Later shipments were made with the plums placed so their tips would be up when the container was opened for inspection. Jostling in rail transit, normal shrinkage and settling of the plums, and rough handling at the terminal markets, however, very nearly obliterated any semblance of face.

It was apparent that the jumble-fill did not provide a sufficiently firm or sufficiently even support for the face. Consequently, a double face with jumble-fill method of packing was devised. The first face was to provide the necessary attractive appearance, and the second face was to provide an even support for the first face.

The double face procedure improved the appearance of the upper face when it was inspected at the terminal market but created serious problems in the packing shed. The double face added to the length of time required to complete the pack and did not leave enough room in the containers for an efficient fill. If the pack was not full and was underweight, the addition of enough plums to reach the desired net weight frequently resulted in excessive pressure bruising. If the pack was overfull, the removal of a few plums frequently created voids which permitted even the double face to go slack.

Toward the end of the 1953 season, a shim was placed between the face and the fill to provide stability for the face. This brought the face to the eastern markets with the desired orderly appearance.

With the introduction of the full telescope container as a replacement for the 10B-23, the face and fill method had to be abandoned since this type of container could not be packed that way unless the case was sealed after packing. Thus, the operation was reversed; the fill was made first and the face last.

Later a fiberboard tray was substituted for the shim. This permitted removal of the face for inspection of the fruit beneath it without spilling or disarranging the plums in the face. The tray and the entire weight of the face were supported by only a few plums which were highest in the jumble-fill. These few were rather severely bruised in shipment. Introduction of the row faced tray laid directly on top of the jumble-fill was intended to indicate to the buyer both the size of the plums he could see and the size of the plums jumbled beneath the tray. Still, the buyers remained wary of the jumble-fill.

Face-Pack with Fill Place-Packed

A place pack was evolved as a substitute for the jumble-fill in order to:

1. Provide a more secure and more even foundation for the tray, thereby reducing pressure bruising beneath it.

2. Meet buyer resistance to the jumble-fill.

3. Make a more orderly pack, thus regulating the height and weight of the fill.

This place pack consisted of arranging the plums loosely in such a manner that the layers would nest one on another to the extent necessary to fill the box to the desired level for insertion of the tray and to attain the constant net weight. This required that the plums in the first or bottom layer be so placed that the second and subsequent layers would just fit in the interstices or hollows.

Plums, being fairly round and not wrapped, require a definite depression or cell at the bottom of each box to hold them in the position desired inasmuch as they are to be nested rather than packed tightly side by side. To hold the bottom layer in position until the upper layers were added, a series of indented pads was developed.

Depending on the size of the plum the spacing had to be varied. Pads with depressions in 5 different designs were developed. Each had places for from 25 to 41 plums, varying with the size of the plum. These 5 pads accommodated sizes of plums from a trifle larger than the 4 x 4 to a bit smaller than the 5 x 5. Plums larger than the 4 x 4 do not need a bottom layer arrangement, since they usually may be packed three layers deep without nesting and completely fill the space. Plums smaller than the 5 x 5 can be jumble-filled and still maintain the correct weight with a fairly level surface at the proper height for the tray. (The trade has little objection to the jumble-fill in small sizes.)

A specific example of how the place-packing is done is given below. The packing of a 6-row Santa Rosa plum, comparable to the 4 x 4 plum size in the 4-basket crate, would be as follows:

1. A size 32 pad (which is a pad containing 8 offset rows of 4 indentations in which plums may be spaced) is fitted in the bottom of the container.

2. The first layer is packed by placing 32 4 x 4 size plums, one in each of the depressions.

3. The next layer is packed by placing 32 plums in the interstices of the first layer.

4. The third layer is packed with 32 plums placed in the same manner.

5. The tray is then inserted and packed in the following manner: One row of 6 plums placed tightly across the end; the second row of 5 plums; then a row of 6 and 5 alternately, making a total of 7 rows or 39 plums.

The size or pattern of pad used will, in most cases, directly reflect the size of plum. However, it was found best in some cases--as, for example, in packing the 6½-row Santa Rosa, a smaller plum--to vary the number of layers beneath the tray rather than the number of plums in each layer. For the 6½-row Santa Rosa, the same size pad (No. 32) as for the 6-row was used. However, since smaller plums were used, 4 layers were placed below the tray, making a total of 4 times 32 or 128 plums below the tray. And with 42 plums in the tray, there were 170 plums in all as compared with 135 plums in the 6-row. This resulted in a net weight of 25 pounds of plums in each case. (An illustration of packing a 7-row on a No. 36 pad is shown in fig. 6.)

A practical method of procedure would be to select a pad presumed to provide the correct count for the size being packed and proceed with the packing. If this results in an overweight package, the next lower numbered pad would be used to reduce the total plums in the container. If the package is underweight, a higher numbered pad should be selected. This trial-and-error method need be used only once for each variety and size. Once the packer knows which pad pattern is needed, no further adjustment is necessary. It is important that all plums be of uniform size in the container, and that this size not be changed as the packing progresses, or the total net weight per container will vary.

Extreme variations in size within the container will immediately become apparent because of the uneven condition of the layers which develops if sizing is irregular. When the packing is properly done, variations in size beyond the one-quarter inch allowed are not possible and are easily detected. This should do much to prevent the abuses in sizing possible with a jumble-type fill.

EVALUATION OF NEW CONTAINERS IN COMPARISON WITH STANDARD CRATES IN 1954

Four of the 7 containers evaluated in 1953 were considered good enough to warrant testing in 1954. One of these containers was withdrawn by the manufacturer after he found it impossible to overcome production difficulties. Six additional container models were submitted for appraisal in 1954.

At the start of the 1954 season, a preliminary shipping point evaluation test was conducted for improved versions of the 3 containers which survived the 1953 trials and for the 6 newcomers. Each container was rated on the basis of cost of materials and component parts, packing and loading, adaptability and ease of packing, handling and loading, sturdiness, appearance of container and pack, protection of fruit, and stacking ability.

Following these early season evaluations at the shipping point, the 9 experimental containers were packed and shipped to the New York auction market for evaluation (fig. 7). After study of the performance both at the shipping point and in transit, 3 containers were chosen for further tests in 5 replicated cross-country shipments under commercial conditions. Although all but 2 of the 9 containers performed quite satisfactorily, the 3 were selected arbitrarily. They were the 8B-29 (fig. 8), the 9B-25 (fig. 9), and the 10B-23A.

Since the volume of plums handled by the many packing sheds varies from a few boxes to more than 15,000 a day, it seemed essential that there should be a container adaptable to hand makeup and closure as well as one adaptable

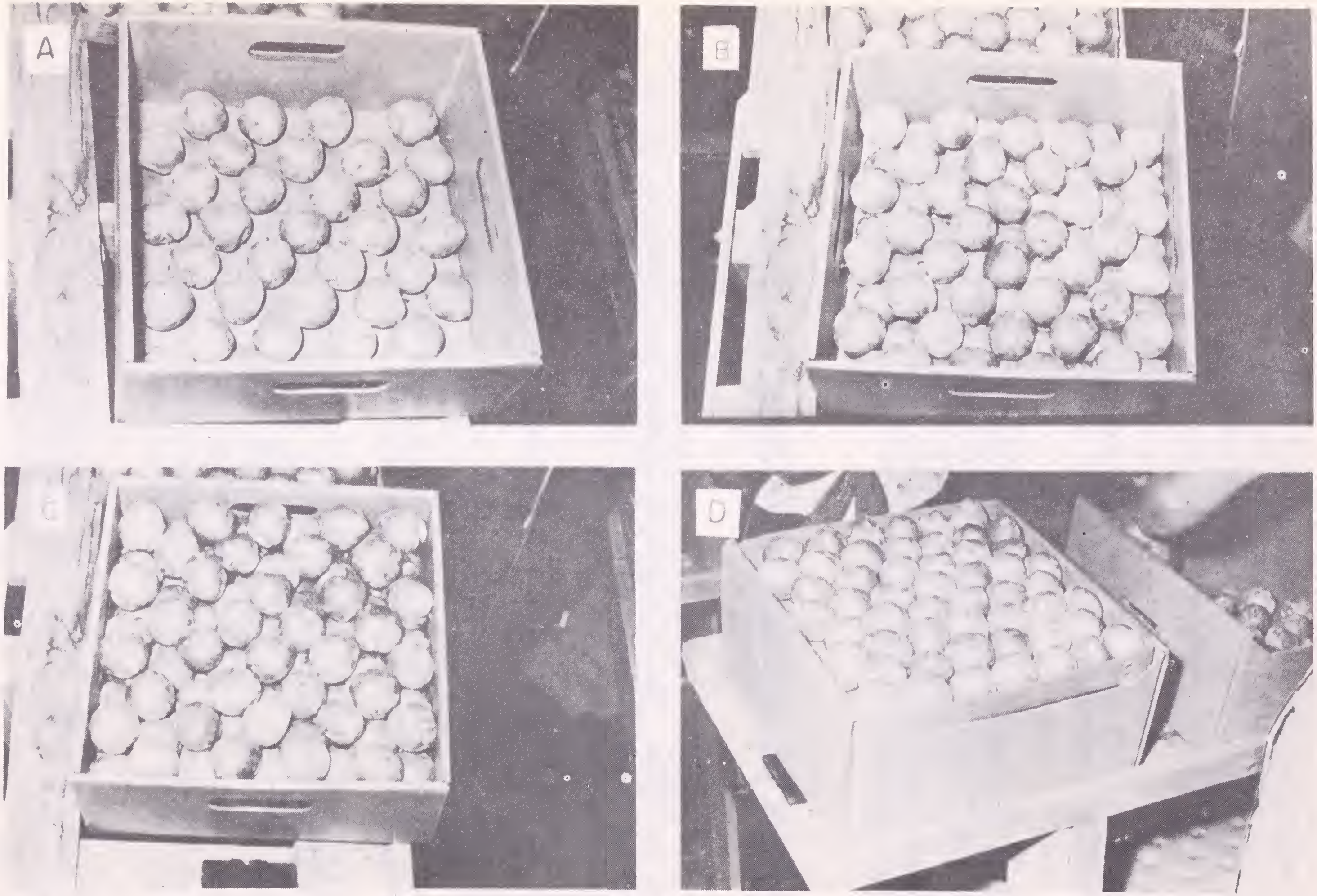

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Figure 6.--At upper left (A) is the start of a place-pack fill. The first layer of Beauty plums has been placed in the indentations of a bottom pad. At upper right (B) plums of the second layer have been rolled into interstices of bottom layer plums which are cradled in pad and hold position. At lower left (C), third layer plums are lined up neatly in hollows of second layer. The positioning of this layer completes an orderly place fill. At lower right (D), one layer is face packed in tray above the fill. The trim alinement of the rows appeals to buyers at the auction market.

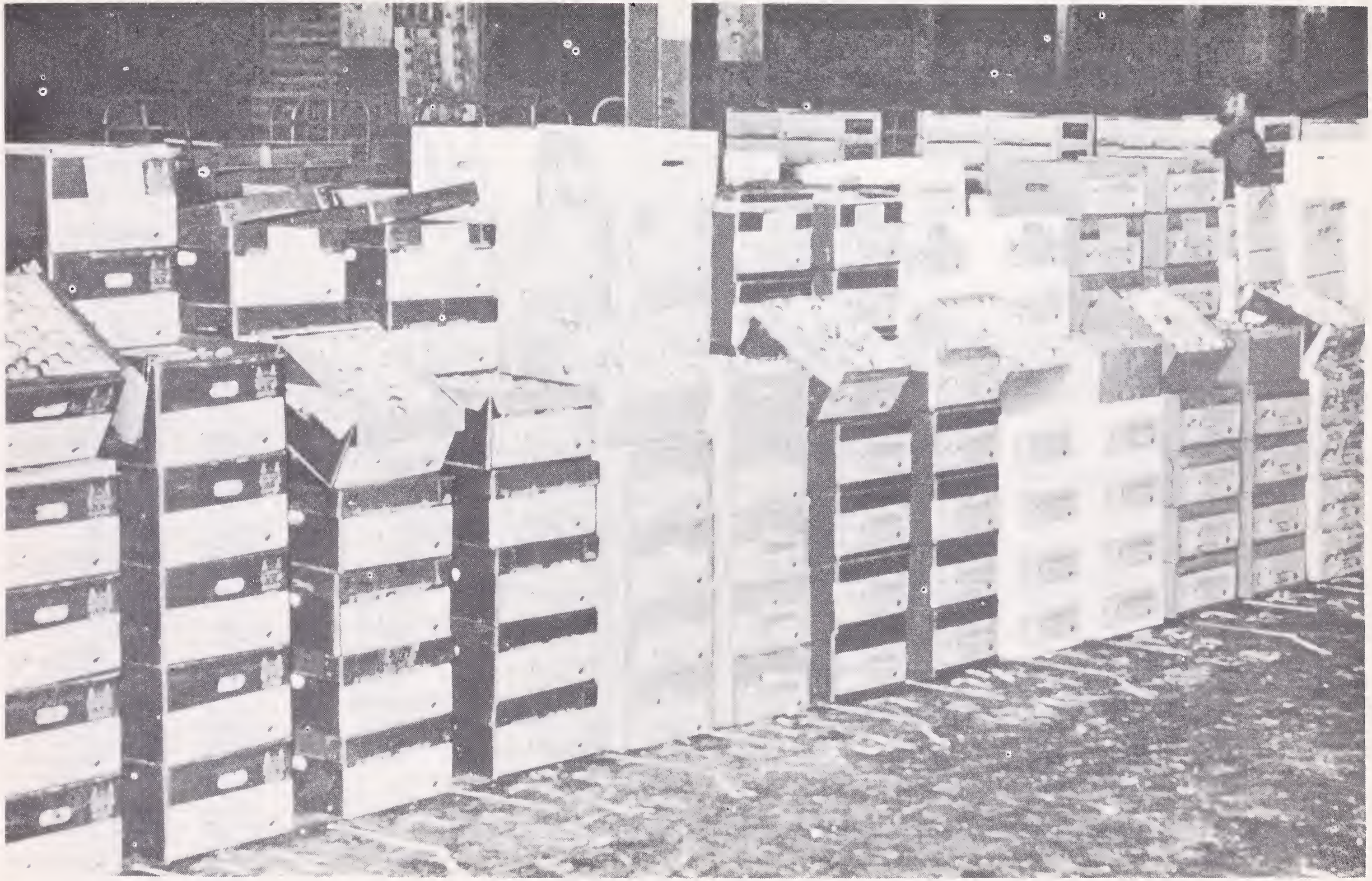

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Figure 7.--After having been unloaded from refrigerated cars at the New York fruit terminal, experimental containers of different designs are on display for buyers.

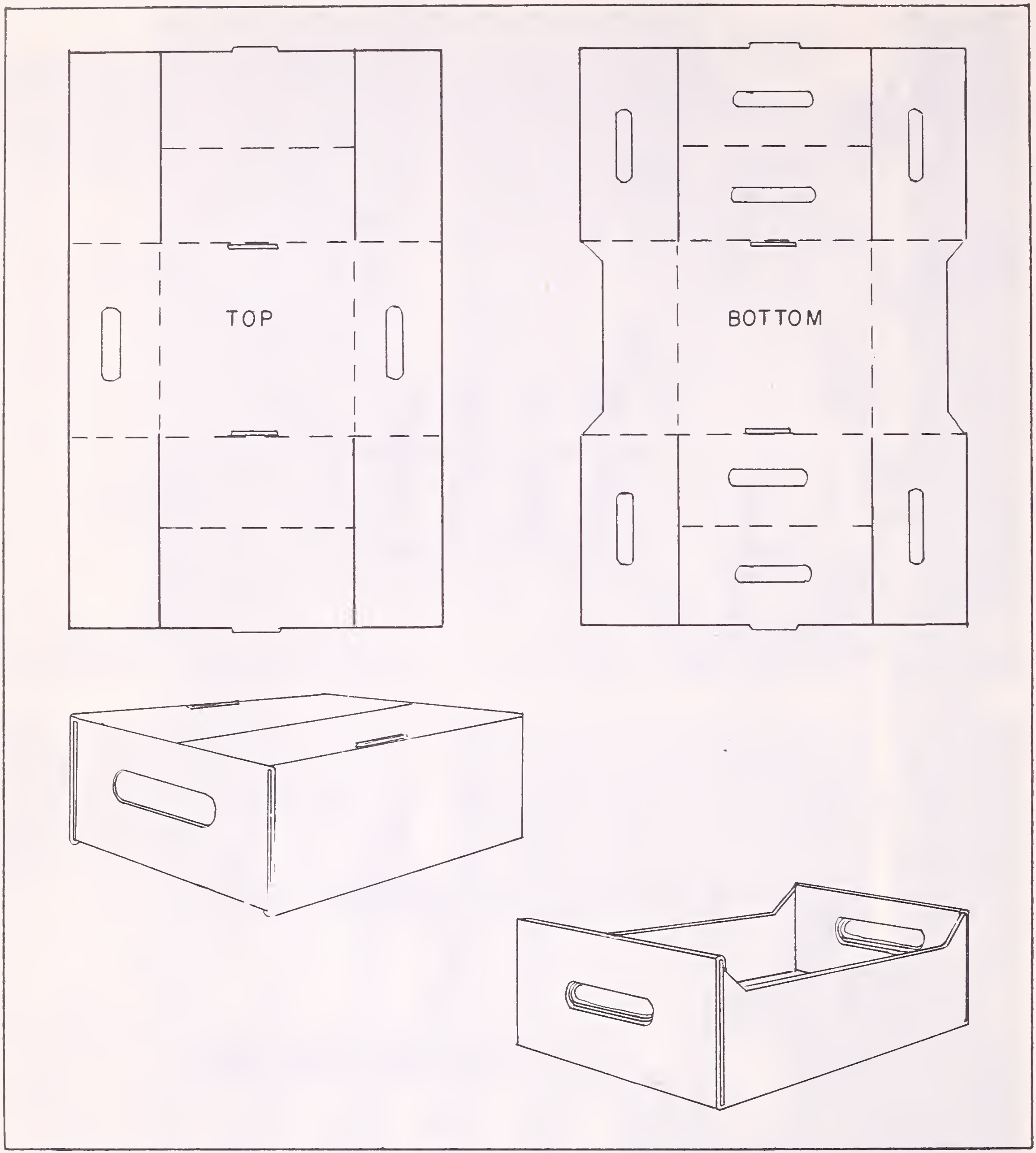

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Figure 8.--The 8B-29 is a sturdy container which can be set up entirely by hand. Neither staples nor glue is needed. Note cut-down sides (lower right) which eliminate appearance of slack pack after plums have settled in transit.

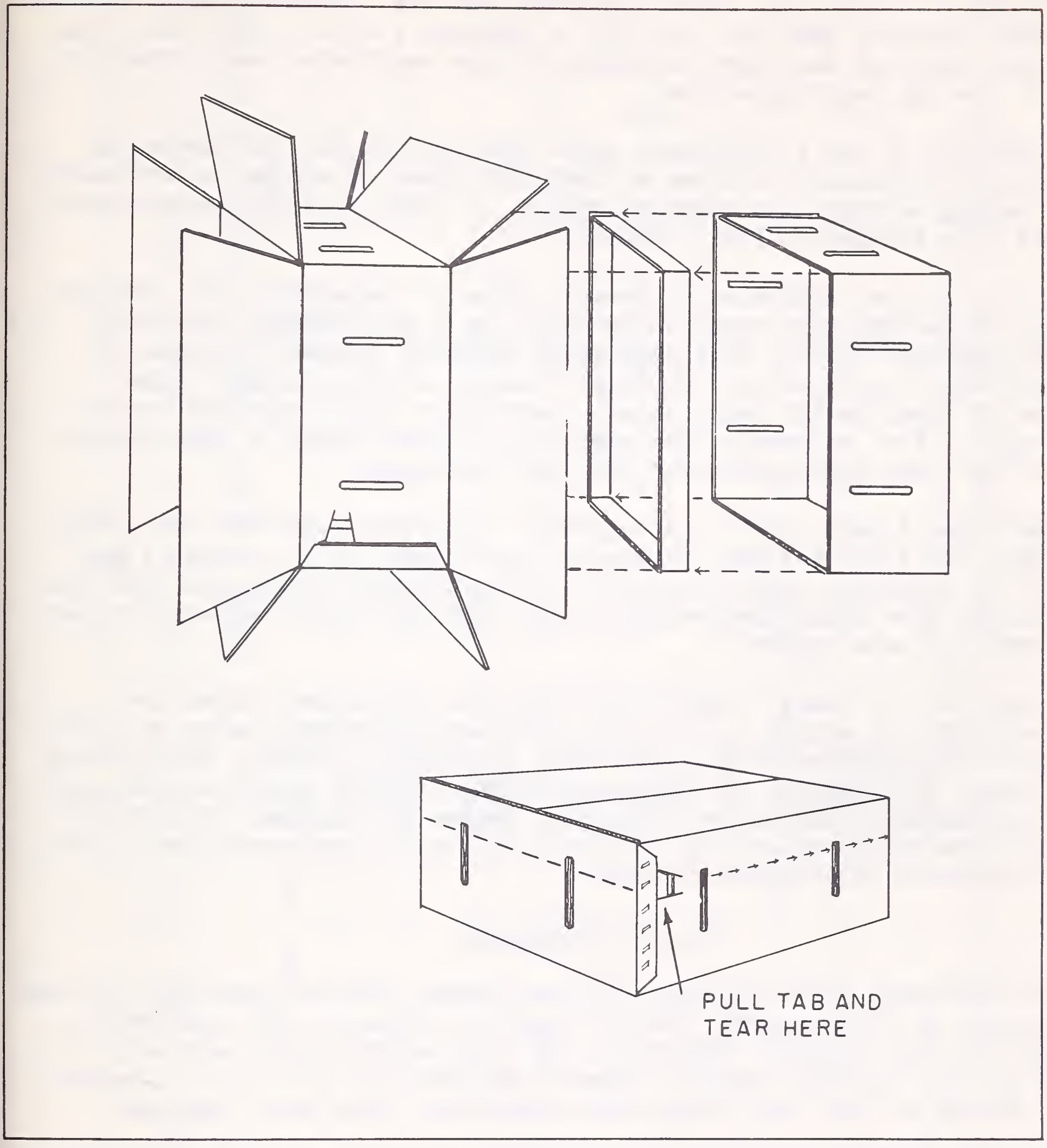

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Figure 9.--Container 9B-25 features a 2-piece liner and a tear tape. When the tab (indicated by arrow) is pulled, the tape comes loose along dotted line, thus freeing the cover. Note main portion of liner (upper right) with a 1½-inch strip liner just to the left. The strip is removed with the cover and prevents the appearance of slackness.

to highly mechanized operations. Container 8B-29 seemed ideal for the former and 9B-25 for the latter use. Container 9B-24, which topped the scoring in the preliminary evaluations, was not selected for the replicated tests because considerable work had been done in 1953 to indicate its potentialities. The 10B-23A was chosen as the third container for the replicated tests primarily because it was the least expensive.

In addition to the 5 replicated tests made in 1954 for the purpose of evaluating the containers selected as indicated above, 3 shipments were made to test loading patterns and spacing devices. A total of 5,511 experimental containers were shipped in 1954 (table 4).

For each of the replicated shipments, plums of comparable size, variety, maturity, and quality were packed in each of the 3 experimental containers and in the standard crate. Each replicated shipment included 3 stacks of each experimental container and at least 3 stacks of the standard crate. There were 42 experimental containers in each stack and 45 standard crates in each stack. Four shipments were made from the west coast to the auction market in New York and one shipment was made to Chicago.

Experienced Federal fruit and vegetable inspectors appraised the condition of both the fruit and the containers upon arrival in the terminal markets. At the auctions, plums packed in the experimental containers were displayed side by side with plums packed in the standard crates and were subject to bids from the same buyers.

On the basis of these 5 replicated tests the researchers determined (a) the estimated or actual cost of the containers, including setup or assembly; (b) the estimated or actual labor cost of packing, filling, and closing; (c) the amount and severity of pressure bruising to plums packed and shipped; (d) the appearance of the packed container, degree of slackness of pack and looseness of pack; (e) salability of plums; (f) trade acceptance; and (g) net returns to growers or shippers of plums.

Cost of Containers

In 5 replicated test shipments standard crates carried plums with an average net weight of 28.6 pounds. The net weight of plums in the experimental containers was 24.2 pounds. Therefore, 118 experimental containers would be required to ship the same volume of plums that would be held in 100 4-basket crates. It was on this ratio that crate equivalent costs were computed.

Estimated comparative costs for materials, assembly, packing and loading fresh plums marketed in experimental containers and in 4-basket crates in 1954 are listed in table 5. No especially designed packing lines were available for packing the experimental containers. Estimated costs of packing them therefore were based on limited studies and the judgment and industry experience of the researchers. Therefore, the data should be regarded as indicating the potential rather than actual savings.

Table 4.--Test shipments of plums packed in specified experimental containers and in 4-basket containers by date, variety, point of origin and destination, 1954

Shipment code No.	Date of shipment	Point of origin	Date sold	Place sold	Variety	Experimental containers				Standard crates	
						8B-29	9B-25	10B-23A	Other	4-basket crates	Other
						Number	Number	Number	Number	Number	Number
1 a/	6/4	Edison	6/14	New York	Beauty	42	-	35	134	950	-
2 a/	6/8	Reedley	6/17	do.	do.	42	42	36	258	605	-
3 b/	7/12	Exeter	7/20	do.	Santa Rosa	126	126	126	84	555	-
4 c/	7/24	Penryn	8/1	do.	Duarte	296	293	40	-	-	-
					Various	65	65	322	-	-	-
5 b/	7/16	Loomis	7/26	do.	Duarte	126	126	126	84	135	-
					Various	-	-	-	-	-	632
6 b/	7/17	do.	7/25	do.	Duarte	126	126	126	84	261	-
					Various	-	-	-	-	233	-
7 c/	8/16	do.	8/24	do.	Various	210	-	252	-	523	-
8 b/	7/29	Tudor	8/4	Chicago	L. Tragedy	126	126	126	84	40	650
9 b/	8/13	Loomis	8/22	New York	Kelsey	126	126	126	64	135	-
					Various	-	-	-	20	405	-
10 c/	8/19	Newcastle	8/29	do.	Various	1,069	-	-	-	-	-
				Total containers........		2,354	1,030	1,315	812	3,842	1,282

a/ Preliminary trial shipment.
b/ Replicated test shipment.
c/ Loading test shipment.

Table 5.--Estimated comparative costs for packing and loading fresh plums marketed in experimental containers and in 4-basket crates, 1954

Item	Experimental containers (24.2 lb. net)			4-basket crate (28.6 lb. net)
	10B-23A	9B-25	8B-29	
	Dol.	Dol.	Dol.	Dol.
Packing and loading costs:				
Container costs:				
Container 1/	0.244	0.268	0.336	0.370
Pads, etc.	.030	.030	.030	.190
Assembly	.010	.010	.010	.020
Total container costs	0.284	0.308	0.376	0.580
Packing labor costs:				
Receiving, sorting and handling	.152	.152	.152	.180
Packing	.100	.100	.100	.160
Closure	.005	.005	.005	.010
Total packing labor costs	0.257	0.257	0.257	0.350
Loading costs:				
Materials	.010	.010	.010	.035
Labor	.040	.040	.040	.035
Total loading costs	0.050	0.050	0.050	0.070
Total packing & loading costs	0.591	0.615	0.683	1.000
Cost per pound	0.0244	0.0254	0.0282	0.0350
Cost per 28.6 lb. (crate equivalent)	.70	.73	.81	1.00
Savings in costs per crate equivalent by using experimental container	0.30	0.27	0.19	-

[1] Experimental container costs include cost of tray.

Note: The 9B-24, which was tested in 1953 and used commercially in 1955, cost approximately 35 cents in 1954. This included container pad and tray but not the self-locking lid introduced in 1955.

Cost of Materials and Assembly

Based on quotations received from the largest suppliers, the cost of the assembled standard crate was 58 cents. This included 37 cents for the materials for the crate itself; 19 cents for its 4 baskets, 8 shims, 4 collars, and liner; and 2 cents for assembly or makeup.

The cost of the experimental containers, including tray, idented bottom pad, and makeup, ranged from 28.4 cents for the least expensive to 37.6 cents for the most expensive. On a crate equivalent basis this range was from 35.6 cents to 44.4 cents.

Materials for the experimental containers, including the tray, ranged from 24.4 cents to 33.6 cents. The indented bottom pads to facilitate place-packing were estimated at 3 cents, and the cost of makeup was estimated at 1 cent. One of the experimental containers can be assembled by hand. The others would require equipment for stapling or gluing. The prices quoted for the experimental containers included a minimum of printing in a single color. If more printing or more than one color was desired, or if a brand label was to be affixed, the charge would be higher.

Suitability and Cost of Packing

It was discovered that the experimental containers could be place-packed about as fast as they could be jumble-filled. This was because the number of the plums in the fill was determined by the pad appropriate for the size of the plum and the packer was not required to fill corners or add or subtract plums to fill the container to the proper level.

Accurate mechanical sizing was not employed by the shippers cooperating in the place-packing development. However, there was general agreement that the place-packing and mechanical sizing promised to work well together. If this promise holds true, expensive eye-sizing could be eliminated.

The average cost of packing the standard crate was based on a survey of the industry made by the administrators of the California Tree Fruit Agreement. Crate packing is done almost entirely on a piece-work basis. Because the experimental containers were new, the packers had to be taught the packing method. Therefore, it was thought advisable that the packing should be done carefully on an hourly wage basis. This made direct comparison of labor costs difficult. Consequently, packinghouse personnel, foremen, and shed managers were asked to estimate the comparative cost of packing the experimental containers. An average of their estimates indicated the theoretical packing cost of the experimental containers to be 10 cents as compared with a cost of 16 cents for packing the 4 baskets in the standard crate. In the 5 replicated test shipments, as has been noted, each experimental container held an average of 24.2 pounds of plums and each standard crate 28.6 pounds. Thus, on an equivalent weight basis the cost of packing in an experimental container was 11.2 cents compared with 16 cents for the standard crate, or a saving of 4.8 cents.

The labor cost of 18 cents per crate for receiving, sorting, and handling the plums, was the same for the experimental containers on a crate equivalent basis as for the standard crates. When required equipment changes are made and new machines are developed to take advantage of all potential savings offered by the experimental containers, it is believed that appreciable reductions will also be realized in these costs.

For the experimental containers the cost of closure was estimated at one-half the 1-cent cost for the standard crate. However, for 1 of the 4 satisfactory experimental containers case sealers will be required before efficient closure will be possible.

On a crate equivalent basis the 3-cent per crate charge for overhead, supervision, and management was estimated to be the same for the experimental containers. Again, on a crate equivalent basis, the cost of precooling the experimental containers was estimated at approximately 10 percent more because of some evidence that fruit in the standard crates cools more quickly than fruit in the experimental containers.

Suitability and Cost of Loading Devices 2/

In solid loads of packages of all one size and design, it was found that because of their flexibility fiberboard containers needed no center gate to take up lengthwise slack. Without this brace the more rigid wooden crates are subject to severe damage.

One new fiberboard container with an overlapping cover, which created air channels between the rows where the covers in adjacent rows came in contact and held the rows apart, was shipped with neither center gate nor spacers. Containers without the protruding lid to aid ventilation would be unsafe for shipment of non-precooled fruit or of precooled fruit in which the temperature had not been sufficiently reduced. Several successful shipments were made without spacers when fruit had been in cold storage for several days.

To evaluate the performance of different row spacing devices three test shipments were made in 1954. Three types of spacers were tried--an individual spacer, a vertical spacer wedged between each pair of adjoining stacks (fig. 10), and a horizontal spacer laid crosswise in the car between each layer of containers (fig. 11). All three were of fiberboard to avoid the creasing caused by wood.

2/ P. L. Breakiron, transportation economist, Marketing Research Division, Agricultural Marketing Service, assisted in evaluating alternative loading methods and devices, and the experimental containers with respect to their suitability for loading.

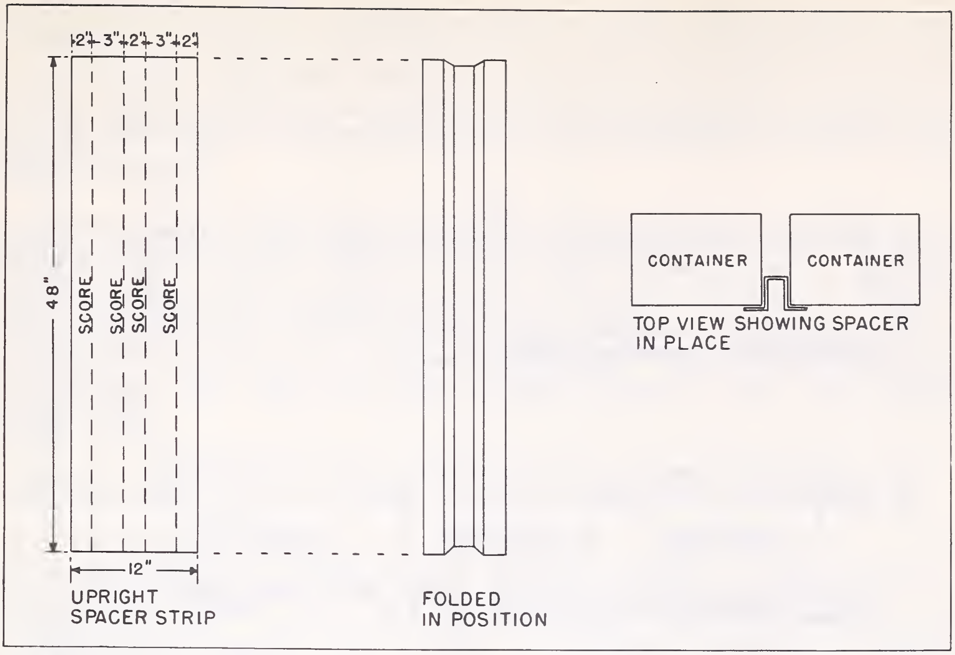

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Figure 10.--Vertical spacers were formed as indicated above. The flat strip of fiberboard (left) was folded along the dotted lines to form a rectangular wedge. This was forced between adjoining stacks of containers to hold them apart, as shown at right.

The individual spacer was tried in the bottom and alternate layers. To be effective this spacer must be used on every container in every layer. Use of these spacers between stacks in each layer would add considerably to the time required to load the car and the cost would not be much lower than for the wood center gate and spacing units used with the 4-basket crate.

The vertical spacers tested were not tall enough to prevent the top layer from shifting. With the dimension of the long axis of the spacer adjusted to the height of the stacks this spacer might have performed satisfactorily.

The horizontal spacer was effective only in those layers with another layer on top to hold it in place. To prevent the top layer from shifting it was found necessary to glue, staple, or tape the spacers in place.

The tests to this point gave valuable information on the usage and performance of the various spacing devices and also indicated a need for certain modifications. However, these modifications must be subjected to continuing trials before their value can be determined.

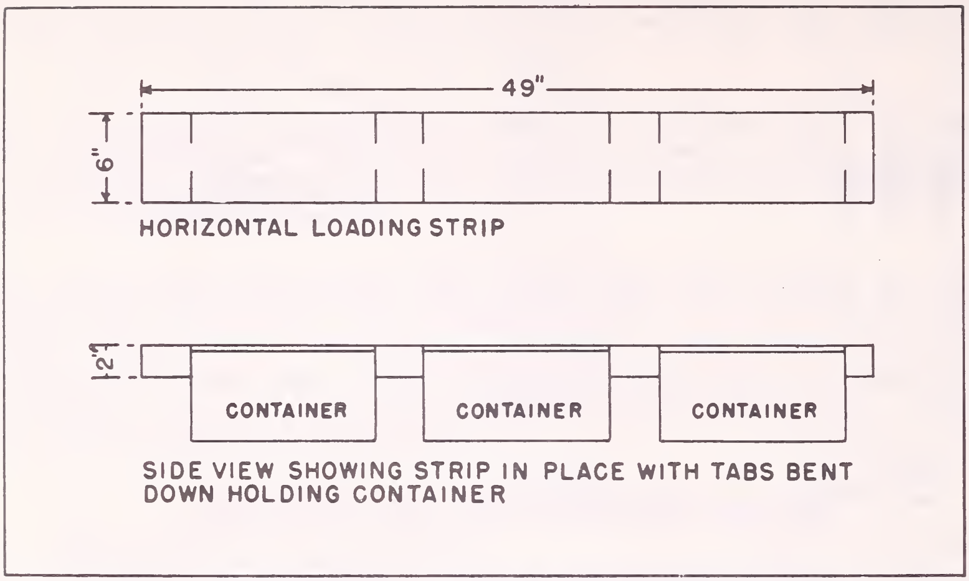
49"
6"
HORIZONTAL LOADING STRIP
2"
CONTAINER
CONTAINER
CONTAINER
SIDE VIEW SHOWING STRIP IN PLACE WITH TABS BENT DOWN HOLDING CONTAINER

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Figure 11.--These horizontal spacer strips were laid over the containers crosswise in the car. The 2-inch tabs of fiberboard between the cuts (indicated by short vertical lines) were bent down between adjoining rows to keep them apart and maintain ventilation channels. Best results were obtained when the tabs were taped down--not just bent.

Comparative 1954 costs of materials used for bracing and spacing a carload of the standard 4-basket crates and for various methods of spacing the experimental containers, which need no bracing, were as follows:

Wood braces and spacers for standard crate..	$30 to $40	per car
Individual spacers for cartons..............	$0.025	each
	1050	needed per car
	$26.25	cost per car
Vertical spacer strips for cartons..........	$0.05	each
	210	needed per car
	$10.50	cost per car
Horizontal spacer strips for cartons........	$0.03	each
	348	needed per car
	$10.44	cost per car

With approximately 1,000 4-basket crates to the car the materials cost per crate averaged 3.5 cents. Loading labor also was estimated at 3.5 cents per crate. This labor included stacking the crates in cars, installing prefabricated gate frames between adjacent stacks to maintain ventilation channels, squeezing the load to take up slack, and installing a center gate to hold the load in place.

With approximately 1,050 experimental containers per car the cost of either vertical or horizontal spacer strips was estimated at 1 cent per container. Loading labor was estimated at 4 cents per container. This included stacking the containers and installing spacer strips. It often was necessary to tape the spacers in place to prevent shifting. It also frequently was necessary to squeeze the load in order to make room for the last stack in the center doorway area.

Arrival Condition of Plums in 1954 Replicated Shipments

In the 5 replicated tests conducted in 1954, plums shipped in 3 selected experimental containers all showed more slight bruising, more damage by bruising, and more severe damage than did plums shipped in the standard crates. Results of examinations made upon arrival at terminal markets by Federal inspectors are shown in table 6.

The average percentage of plums sustaining slight bruising in the experimental containers was 11.7 percent and the average in the 4-basket crates was 7.8 percent. The difference among the experimental containers was much less. Slight bruising in the 8B-29 averaged 11.2 percent in the 5 shipments; in the 9B-25 it averaged 11.6 percent; and in the 10B-23A it averaged 12.4 percent.

Damage by bruising, which may affect grade, averaged 2.9 percent in the experimental containers in a range from 2.4 to 3.4 percent for the individual containers. Damage by bruising in the 4-basket crates averaged 1.4 percent.

Serious damage to plums in experimental containers ranged from 0.8 percent to 1.4 percent and averaged 1.0 percent. In 4-basket crates, serious damage averaged 0.4 percent. Decay was not considered a problem in either the experimental containers or the standard crates. In the experimental containers, decay averaged 0.6 percent and in the standard containers 0.4 percent.

Trade Acceptance and Salability of Plums

At 5 auction sales at terminal markets where prices were compared directly in 1954, plums in the experimental containers sold for more on 3 occasions and plums from the same shipment packed in 4-basket crates sold higher on 2 occasions.

When all sales were totaled, it was found that average prices paid were almost the same, regardless of the container in which the plums were packed. The price range for plums in experimental containers was from 11.1 cents to

Table 6.--Arrival condition at terminal market of plums packed in experimental containers and of plums packed in 4-basket crates, by percentage of plums sustaining slight bruising, damage by bruising, serious damage and decay, 5 replicated tests, 1954 (as indicated by inspection certificates of the Fresh Products Standardization and Inspection Branch, Fruit and Vegetable Division, Agricultural Marketing Service, U. S. Dept. Agr.)

Shipment code No.	Place of inspection	Variety of plums	Experimental containers												Standard			
			8B-29				9B-25				10B-23A				4-basket crates			
			SB 1/	DB 2/	SD 3/	DK 4/	SB 1/	DB 2/	SD 3/	DK 4/	SB 1/	DB 2/	SD 3/	DK 4/	SB 1/	DB 2/	SD 3/	DK 4/
			Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
3	New York	S. Rosa	14	7	1	0.5	14	3	0	0.5	15	6	3	0.5	9	2	0	0.5
5	do.	Duarte	15	2	1	1	15	3	2	1	15	4	2	0.5	13	3	2	1
6	do.	do.	15	3	2	1	15	4	2	2	20	7	2	1	5	2	0	0.5
8	Chicago	L.Tragedy	3	0	0	0	3	0	0	0	3	0	0	0	5	0	0	0
9	New York	Kelsey	9	2	0	0	11	2	0	1	9	0	0	0	7	0	0	0
		Average	11.2	2.8	0.8	0.5	11.6	2.4	0.8	0.9	12.4	3.4	1.4	0.4	7.8	1.4	0.4	0.4

1/ SB - Slight bruising not affecting grade.
2/ DB - Damage by bruising--excludes serious damage.
3/ SD - Serious damage.
4/ DK - Decay.

Note: When inspector reported *less than 1 percent decay* it was tabulated at 0.5 percent.

21.6 cents a pound and for plums in standard containers from 10.2 cents to 22.9 cents a pound. The average price per pound paid was 18.5 cents for plums in experimental containers and 18.4 cents for plums in standard crates (table 7). This was in contrast to prices received in the earlier 1953 tests when prices of plums in the standard crates were 1.2 cents a pound higher than the plums in the jumble-filled experimental containers.

Table 7.--Comparison of auction selling price per box and per pound of comparable size plums packed in 4-basket crates and packed in experimental containers, 5 replicated test shipments, 1954

Test shipment code No.	Shipping point	Variety	Place sold	Date sold	Experimental container: Price per box	Experimental container: Net weight	Experimental container: Price per pound	Standard 4-basket crate: Price per box	Standard 4-basket crate: Net weight	Standard 4-basket crate: Price per pound
					Dol.	Lb.	Ct.	Dol.	Lb.	Ct.
3	Exeter	S. Rosa	N.Y.	7/20	5.39	25	21.6	6.23	29	21.5
5	Loomis	Duarte	do.	7/26	5.13	25	20.5	6.07	29	20.9
6	do.	do.	do.	7/25	5.15	24	21.5	6.63	29	22.9
8	Tudor	L.Tragedy	Chi.	8/4	4.06	23	17.7	4.35	26	16.7
9	Loomis	Kelsey	N.Y.	8/22	2.66	24	11.1	3.07	30	10.2
			Average		4.48	24.2	18.5	5.27	28.6	18.4

There was very little difference in the average prices paid for plums packed in different types of experimental containers. Plums in the 8B-29 sold for an average of $4.52 per container. Plums in the 10B-23A averaged $4.46 per package and plums in the 9B-25 averaged $4.48. Unlike the previous year, all the new containers were printed in color and some shippers affixed bright brand labels to add to the appearance of the containers.

PROGRESS AND APPRAISAL OF 1955 COMMERCIAL SHIPMENTS OF NEW CONTAINERS

During the 1955 plum shipping season about 30,000 fiberboard containers were packed and shipped to eastern markets by at least 20 plum packing plants located in the San Joaquin Valley, the Sacramento Valley, and the foothill district of the western slopes of the Sierra Nevada Mountains in California. The containers were shipped to principal auction markets in the eastern States or sold on an f.o.b. basis at shipping point.

Only 2 of the 4 containers which had been found quite satisfactory in 1953 and 1954 were used commercially in 1955. They were the 9B-24 and the 8B-29 containers. The 9B-24 container used in 1955 was essentially the same as the one used in 1953, except that it had a self-locking 2½-inch roll end cover in place of the 2-inch design style cover which was stapled to the container in 1953. About half of the 30,000 fiberboard containers shipped in 1955 were the 9B-24 containers and the other half 8B-29 containers.

Cost of Containers

The actual cost of the new containers used in 1955 by all of the 20 packing sheds was not determined. However, in one known case the experimental container 8B-29 was supplied to the grower complete with bottom pad and tray, at a charge of 42.65 cents. This was 6.05 cents more than the cost of the 8B-29 container used in 1954 commercial test shipments. In another instance growers were charged 40 cents for the modified 9B-24 container in 1955. The modified 9B-24 container was relatively more expensive than the one used in 1953, primarily because of the additional feature of the self-locking cover which cost 4.7 cents in this one instance. There were other reasons for the increase in cost of fiberboard containers in 1955, including:

1. Containers were generally purchased in lots of 5,000 or less in 1955, while container manufacturers' quotations made in 1954 were on a basis of carlots of approximately 15,000.

2. Printing was done in at least 2 colors, and in many cases the inner and outer case both were printed.

3. The cost of art work for the printing design, and of the dies, was charged to the containers used. This cost would not be duplicated in future runs. In some cases this was as high as 2½ cents per container.

4. Indent bottom design pads were more costly than anticipated since one supplier charged the cost of dies to the selling price on a 1-year recovery basis.

5. Increase in carton size from 6½ to 7 inches in depth.

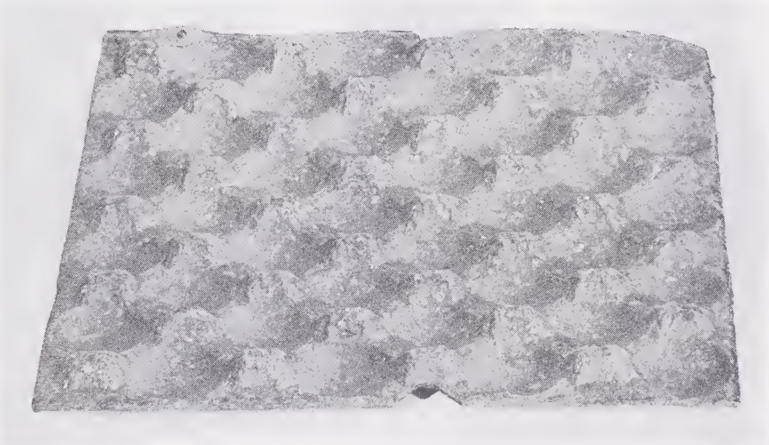
Although, in general, the cost of fiberboard containers was higher in 1955 than had been estimated in 1953 and 1954, the costs of materials for the 4-basket crates were slightly lower in 1955 than in 1954, as a result of a 10-percent decrease in shook prices (prices of materials) which were later raised 5 percent, making a net reduction of about 5 percent. Therefore, the cost of crate shook to any individual packing shed in 1955 would depend on the time of purchase of the season's requirements. One supplier of crate material charged growers an average of 53.6 cents depending upon the size of the end of the box and the number of cleats used, etc. Another supplier charged an average of 55.5 cents.

In one packing shed where the 4-basket crate and experimental container 8B-29 were commercially packed for the grower, the charge for container materials, labor and handling was 95 cents for the 4-basket crates and 75 cents for the experimental container.

The 5 numbered design bottom pads developed in 1954 served adequately for all sizes and varieties of plums packed in the new containers in 1955. Varieties packed commercially in 1955 included:

Beauty
Santa Rosa
Tragedy
Burbank
Gaviota
Formosa
Duarte
Giant
Late Santa Rosa
Ace
Late Tragedy
Wickson
Kelsey
Late Duarte
President
Sharkey

The indented bottom pads used in 1954 shipments were individually hammered or pressed out by the use of a homemade platen or die. The materials used were either corrugated fiberboard or a laminated cellulose approximately a half inch thick. These homemade pads were not practical for commercial use. The pads used in 1955 were made of molded pulp material of varying texture manufactured by 3 different makers. These pads served to hold the plums in place and the 2 softest also acted as a cushion (fig. 12).



NEG. BN-2552

Figure 12.--A newly developed, molded pulp indent pad which was introduced in 1955 commercial shipments.

The material in the tray also was changed in 1955. The stiff corrugated tray used in 1953 and 1954 was replaced by a tray of molded pulp or chipboard. These trays were flexible rather than rigid and yielded to the pressure of the plums above and beneath them.

The containers were increased in depth from $6\frac{1}{2}$ inches to 7 inches in order to reduce the amount of overpacking necessary to attain the desired net weight of 25 pounds.

Only a very small percentage of the season's run of plums was packed in the new containers in any one packing plant. Therefore, no special equipment or packing lines were set up for most efficient packing and handling of the containers. For this reason there was no opportunity to determine potential savings that might be realized by the use of case sealers, conveyors, special hand-trucks, packing stands, etc.

Most of the packers had insufficient time to attain high packing efficiency and speed with the new containers. The majority, working but briefly on the new pack, received an hourly wage and had little incentive to speed up. It was noted in several instances where a single packer was assigned the packing of a considerable number of the new containers, on a piece-work basis, that rapid packing was possible. In one case an experienced crate packer, with a normal rate of 12 to 14 crates per hour, packed 24 of the new containers in an hour, after only about 6 hours' experience with the new package (fig. 13).

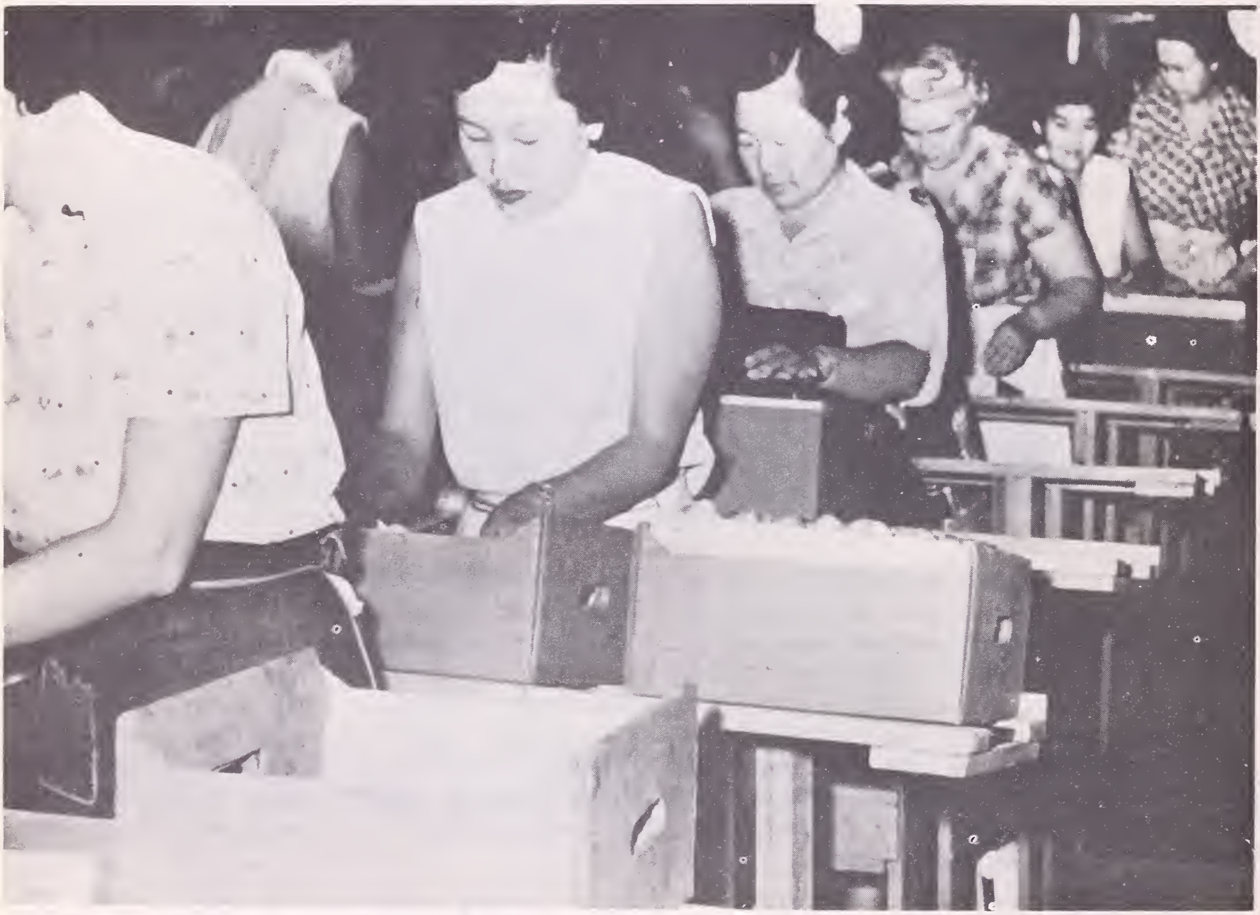


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Figure 13.--Packing the experimental containers was a new experience and most packers did not attain the speed they maintained while working on more familiar packs. This container is the 8B-29.

Methods of Loading

With few exceptions, all of the 1955 shipments of the new containers were loaded with either a solid through load or, if ventilation channels were desired, the horizontal spacer strip was used. Fruit cooled to a pulp temperature of approximately 40 degrees was shipped in solid or through loads, all of which arrived at the destination in good condition.

The horizontal fiberboard spacing strips were either unsecured or were taped to the containers in the top layer with a pressure sensitive mastic type tape 1-inch wide. End to end shifting developed in the load whenever the containers were not stacked tight lengthwise of the car and side shift occurred in most loads. The side shifting which occurred was due to the failure of the strip tabs to stay in position, thus allowing the containers to slide. On one shipment to Chicago the strip tabs were taped together along the side of the car. All tabs were taped together on the top layer, and the top strip was securely taped to the containers in the top layer. This car showed no shift. This method of spacing containers for ventilation and to secure them against shift probably can be improved. However, 1955 shipments in which care was used in loading, showed little container distortion or damage.

Arrival Condition of Plums

Plums in 12 shipments in 1955 were packed with the assistance of researchers who had developed and evaluated the improved containers and methods of packing them in 1953 and 1954. The 1955 shipments were strictly on a commercial basis. No program of replicated tests, such as the series conducted in 1954, was set up. However, inspection of the 12 shipments was made upon arrival at destination in eastern markets. There were 6 shipments in the 9B-24 and 6 shipments in the 8B-29 containers. Of the 6 shipments in the 9B-24, 5 were by express and 1 by regular freight. All 6 shipments in the 8B-29 were by regular freight. Because of different car handling conditions involved in express movements, test shipments by this form of transportation are not ordinarily subjected to the more severe treatment usually encountered by shipments in rail freight. Specifically, rail express shipments move in comparatively short through express trains and are not switched to interchange or classification yards where most comparatively severe impacts are received by regular freight shipments. Express cars, designed for passenger train service, are better built to withstand transit shock.

Average slight bruising reported in both of the new containers in all 12 shipments in 1955 was higher than the average of slight bruising in the 3 experimental containers in the 5 replicated tests in 1954, but damage by bruising and serious damage by bruising were sharply reduced in 1955. This reduction in damage and serious damage by bruising was attributed to the substitution of flexible trays for rigid trays. This distributed the weight of the plums in the tray more evenly to a larger number of plums below the tray. An increase in the depth of the containers, which permitted a reduction in overpacking, also helped to decrease the amount of pressure bruising. Again, it should be noted that the slight bruising referred to in this report is in fact a slight flattening of the contour of the plums which in no way affects the quality of the plums.

Analysis of Prices Received

Plum growers and shippers, of course, are vitally interested in shipping plums in containers which yield highest market prices. Therefore, they watched very closely the prices received for plums packed in the experimental containers in 1955, and compared them with prices received for plums packed in 4-basket crates. However, there are many pitfalls in making such comparisons as can be seen below.

In comparing the 1955 season's all auction weighted average price of plums sold in 4-basket crates and in the new fiberboard containers, it was found that through September 10, 2,250,953 crates sold at an average of $3.99 per crate, while 24,555 new containers sold for an average of $3.71 each.[3/] If it is assumed that the average net weight of plums in the 4-basket crate is 29 pounds and in the new containers 25 pounds, the net price per pound in the crates would be 13.8 cents and in the new containers 14.8 cents.

On its face, this would seem to indicate a substantial price differential in favor of plums in the new containers. However, the season figures do not take into consideration the prices paid for different varieties and different sizes, and the fact that the 4-basket crate was sold at each daily auction from the end of May to mid-September, while the new containers appeared only at irregular intervals.

In New York, where most shipments went, the all season average auction price of all sizes of plums by variety is shown in table 8. Plums in crates sold higher by weight in 8 varieties and plums in new containers sold higher in 4 varieties. This comparison ignores different prices paid for different sizes and different prices on different days.

[3/] Source: Federal-State Market News Service Auction Price Summary No. 15, Sacramento, Calif., 1955. On September 10, all known 1955 shipments of plums in the new containers had been completed and the plum shipping season was nearing its end.

Table 8.--New York season average auction prices paid for plums in 4-basket crates and in new containers, all sizes by variety, 1955

Variety	New container: Price per package	New container: Assumed net weight	New container: Price per pound	4-basket crate: Price per package	4-basket crate: Assumed net weight	4-basket crate: Price per pound
	Dollars	Pounds	Cents	Dollars	Pounds	Cents
Ace	3.48	25	13.9	2.90	29	10.0
Beauty	3.57	do.	14.3	4.74	do.	16.3
Burbank	2.90	do.	11.6	2.99	do.	10.3
Duarte	2.35	do.	9.4	2.95	do.	10.2
L. Duarte	2.23	do.	8.9	3.04	do.	10.5
Formosa	3.02	do.	12.1	4.07	do.	14.0
Gaviota	2.07	do.	8.3	2.52	do.	8.7
President	2.69	do.	10.8	3.35	do.	11.6
Santa Rosa	4.71	do.	18.8	5.02	do.	17.3
Sharkey	2.11	do.	8.4	3.14	do.	10.8
Tragedy	4.26	do.	17.0	4.67	do.	16.1
Wickson	2.04	do.	8.2	3.17	do.	10.9

Compiled from AMS:FV - Fruit Branch Plum Price Report, November 1955.

The season average New York auction price of all varieties of plums by comparable size is shown in table 9. By weight, plums in crates sold higher in 3 of the 6 principal sizes traded and plums in the new containers sold higher in 3 sizes. This comparison ignores variety and day to day price variations. It also assumes there are comparable size designations in the crate and in the new container.

Table 9.--New York season average auction price for plums in 4-basket crates and new containers, all varieties by size, 1955

New containers: Size of plums	New containers: Price per package	New containers: Assumed net weight	New containers: Price per pound	4-basket crates: Size of plums	4-basket crates: Price per package	4-basket crates: Assumed net weight	4-basket crates: Price per pound
	Dollars	Pounds	Cents		Dollars	Pounds	Cents
5-row	4.75	25	19.0	3x4	4.35	32	13.6
5½-row	3.18	do.	12.7	3x4x4	4.09	31	13.2
6-row	3.39	do.	13.6	4x4	4.23	30	14.1
6½-row	3.70	do.	14.8	3x4x5	3.27	29	11.3
7-row	3.60	do.	14.4	4x5	3.88	28	13.9
8-row	3.26	do.	13.0	5x5	3.63	26	14.0

Compiled from AMS:FV - Fruit Branch Plum Price Report, November 1955.

Actually there are no exactly equal size designations in crates and in the new containers. The sizes compared in this report are the closest equivalents. The most nearly exact match of all is the 4 x 5 size designation in the crates and the 7-row size in the new containers.

In table 9 it will be noted that the season average New York auction price of plums of all varieties in the 4 x 5 and the 7-row size was $3.88 for plums in crates and $3.60 for plums in new containers. Assuming a net weight of 28 pounds for 4 x 5 size plums packed in the crates and 25 pounds in the new containers, plums in crates sold for 13.9 cents a pound and plums in the new containers brought 14.6 cents.

The New York season average auction price by both variety and by size (4 x 5 and 7-row) is shown in table 10. Plums in crates sold higher by weight in 6 varieties and plums in the new containers sold higher in 5 varieties.

Table 10.--New York season auction price for plums in 4-basket crates and in new containers, by variety and by most nearly equivalent size (4 x 5 in crates and 7-row in new containers), 1955

Variety	New containers			4-basket crates		
	Price per package	Assumed net weight	Price per pound	Price per package	Assumed net weight	Price per pound
	Dollars	Pounds	Cents	Dollars	Pounds	Cents
Ace........	2.40	25	9.6	1.90	28	6.8
Beauty.....	4.04	do.	16.2	5.08	do.	18.1
Burbank....	2.60	do.	10.4	2.62	do.	9.4
Duarte.....	2.20	do.	8.8	2.86	do.	10.2
L. Duarte..	1.70	do.	6.8	2.36	do.	8.4
Formosa....	2.90	do.	11.6	3.40	do.	12.1
Gaviota....	1.61	do.	6.4	2.15	do.	7.7
President..	2.40	do.	9.6	2.63	do.	9.4
Santa Rosa.	4.64	do.	18.6	4.67	do.	16.7
Sharkey....	1.80	do.	7.2	2.16	do.	7.7
Wickson....	1.84	do.	7.3	1.92	do.	6.9

Note: This table lists but 11 varieties, as compared with 12 varieties in table 8, because there is no listing of the sale of Tragedies in the 7-row size.

Compiled from AMS: FV-Fruit Branch Plum Price Report, November 1955.

To narrow the comparisons to plums that sold the same day on the same market, the researchers noted the auction prices of plums from 9 shipments which they inspected upon arrival in New York. In these shipments a large number of the new containers were weighed and found to average 24.6 pounds net. The average net weight of 4-basket crates in the same shipments was estimated at 29 pounds.

At auction, the average crate price was $3.76 and the average new container price was $3.09. These averages included only prices in comparable sizes of the same varieties in the same market on the same day. Applying a net weight of 29 pounds in the crates and 24.6 pounds in the new containers, the per pound price of plums in the crates was 13.0 cents and the per pound price in the new containers was 12.6 cents.

In a final attempt to refine out unmeasured variables, researchers selected a single sale of plums in each of the 4 principal varieties shipped East in the most nearly equivalent sizes, in the same market on the same day and with the same brand. These particular sales were chosen for comparison because the net weights of plums in both new containers and 4-basket crates were determined by actually weighing a large percentage of the packaged fruit. In these 4 sales, 3 varieties of plums sold at higher prices in the crates and 1 variety sold at a higher price in the new containers (table 11).

Table 11.--Comparative selling price of 4 x 5 size plums packed in crates and 7-row size plums packed in experimental containers, 4 varieties, single sales, New York fruit auction, 1955

Variety	7-row size in new container			4 x 5 size in crate		
	Price per package	Net weight	Net per pound	Price per package	Net weight	Net per pound
	Dollars	Pounds	Cents	Dollars	Pounds	Cents
Beauty.......	4.16	24.85	16.7	4.71	25.25	18.7
Santa Rosa...	5.06	25.05	20.2	6.27	28.25	22.2
Duarte.......	3.15	25.0	12.6	4.00	28.3	14.1
President....	2.79	25.16	11.1	3.20	32.5	9.8

Observations of buyer preference and interest shown in the new containers indicated that the buyers displayed the usual reluctance to accept a new package, yet greater numbers of them purchased and distributed the new containers in 1955. Carlot receivers of plums reported that it is probable that should the new container be offered in volume it would command a price commensurate with the size and quality of the plums offered.

One wholesale auction buyer typified the reaction of many when he declared that he was making no attempt to sell plums in the new containers to the retail trade until the new containers start coming to market regularly in volume. He said that if he convinced his customers that the new containers were desirable and if orders were placed with him, he might find no new containers available in the market for several days or even weeks.

ADVANTAGES AND DISADVANTAGES OF INDIVIDUAL CONTAINERS

Recommended inside dimensions of fiberboard containers for shipping plums are 12½ x 12½ x 7 inches. A description and the favorable and unfavorable characteristics of each of 4 containers which were found to be satisfactory are listed below:

Experimental container 8B-29 (fig. 14).--A 2-piece folding full telescope box with roll ends which fold into place. Favorable characteristics:

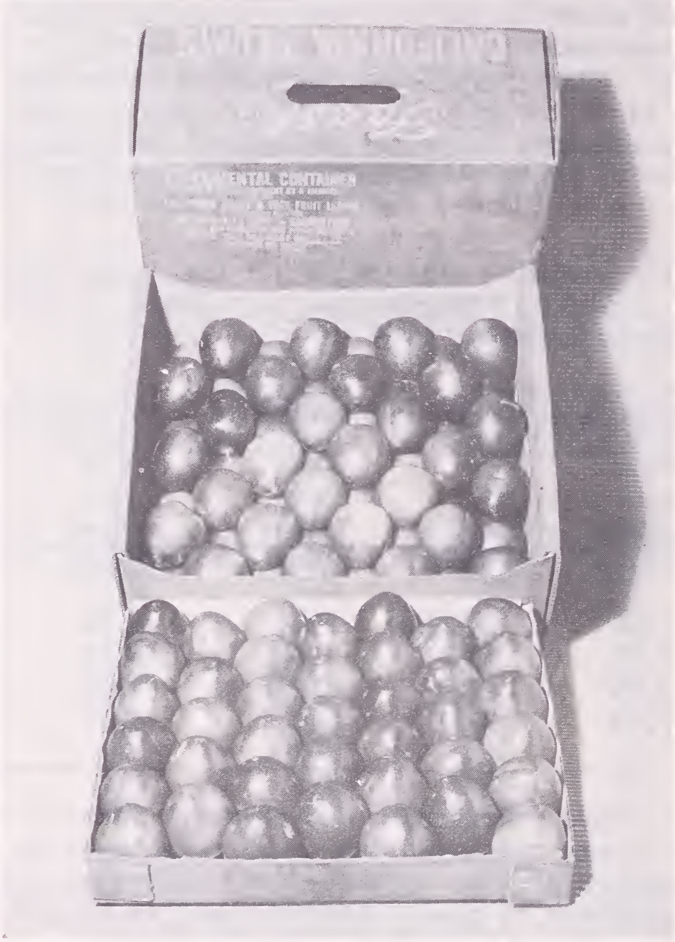

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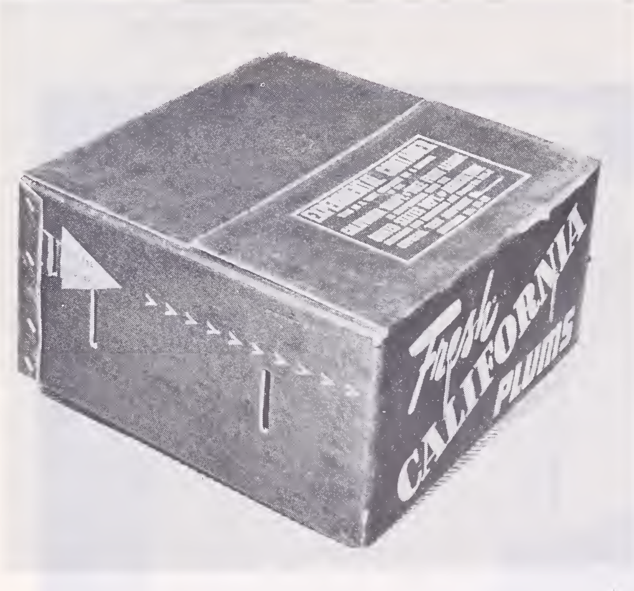
Figure 14.--Experimental container 8B-29 opened. The face tray has been removed to reveal snug, orderly fill attained by place-packing plums in lower part of container. Note cut-down front and rear sides of bottom half of container. This eliminates appearance of slackness following settling of the fruit during transit.

It is most liked by fruit buyers and auctioneers; requires no stapling or gluing; and is easily made up by hand, making it especially suitable for smaller packing plants; has a great stacking strength; is easily opened for inspection and has no appearance of slackness of pack, because sides of inner case are cut down. Unfavorable characteristics: It is relatively expensive and is unsuitable for automatic makeup or closing.

Experimental container 9B-25 (fig. 15).--A regular slotted container with full liner and tear tape feature for inspection opening. Favorable characteristics: Is sturdy; has no appearance of slackness of pack, because the top of an inner liner, 1½ inches deep, is removed automatically with the top, and the fruit extends above the cut-down side; sells for a moderate price; can be mechanically sealed. Unfavorable characteristics: Opening for inspection defaces container and it cannot be securely reclosed without tape or stapling; liner must be inserted.

Experimental container 9B-24 (fig. 16).--A half-slotted container with 2-inch top flaps turned out and down; full depth liner and 2-inch flap design type cover fitting over container flaps. This container is also made with a self-locking 2½-inch roll end cover. Favorable characteristics: It is sturdy; has good appearance; the self-locking cover is easy to close and open for inspection; is easiest and cheapest to load in full carlots, because spacers are



NEG. BN-2558

Figure 15.--Experimental container 9B-25. This is a regular slotted container with tear-tape feature for opening for inspection of plums. The inspector or storekeeper simply grasps the triangular tab (left) and pulls, freeing top.

not needed for ventilation, since side flaps on covers create air channels. Unfavorable characteristics: The flap type cover is slow to lid and requires restapling if opened for inspection. The self-locking cover is fast to lid, but more expensive. Both types must be set up prior to packing; and do not eliminate slack-pack appearance.

Experimental container 10B-23A (fig. 17).--A 2-piece full telescope box with inner and outer case of half-slotted design. Favorable characteristics: It has relatively low cost; is easily opened for inspection; can be mechanically set up and closed. Unfavorable characteristics: It is less sturdy than some of the other containers, bulges under certain stacking conditions, and slackness of pack is apparent at terminal market.

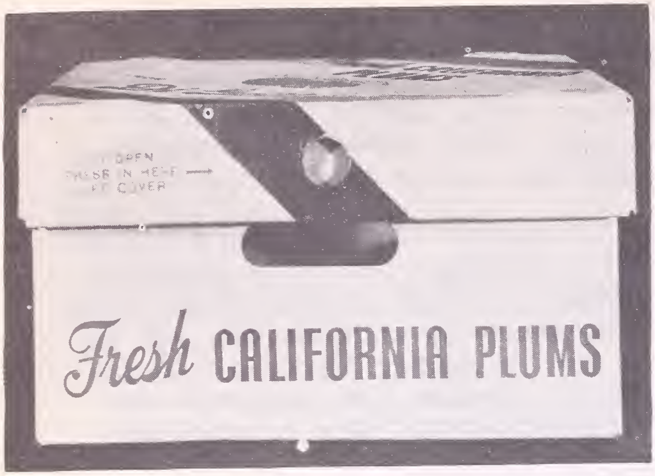


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Figure 16.--Container 9B-24 modified. This container is noteworthy for its overlapping lid which helps create air channels between stacks and rows. In original version lid was stapled in place. This lid locks in place and is released by finger pressure in round hole centered in lid just above handhold.

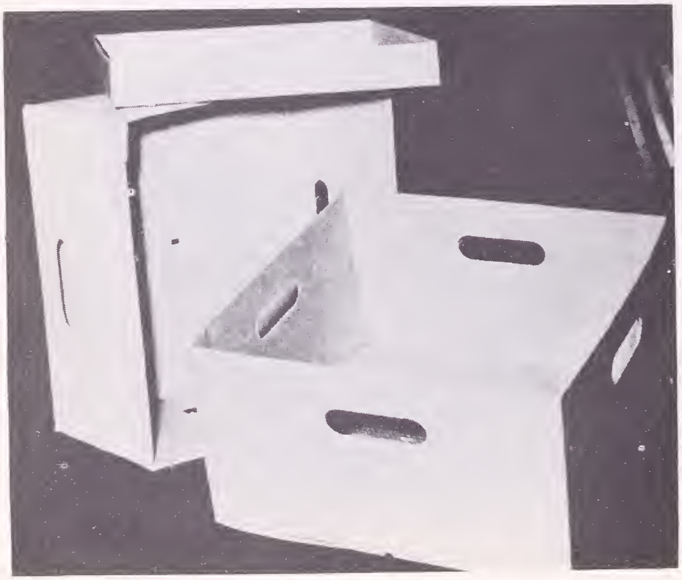

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Figure 17.--Experimental container 10B-23A. This full telescope model was the least expensive of the 4 experimental plum shipping containers. It also had the lowest tare weight and was easy to open for inspection. The bottom is in the foreground and the top to the left, behind. Resting on cover is a tray for face packing.

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